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International Otolological Congress.  
1st, New York, 1876.

REPORT  
OF THE  
FIRST CONGRESS

OF

51

The International Otolological Society.

NEW YORK, SEPTEMBER, 1876.



PUBLISHED BY A COMMITTEE COMPOSED OF

CHARLES J. KIPP, ARTHUR MATHEWSON, J. S. PROUT,  
AND J. D. RUSHMORE.

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ALPHABETICAL LIST OF MEMBERS  
OF THE  
INTERNATIONAL OTOLOGICAL SOCIETY.

---

AGNEW, C. R., New York City.  
ALT, A., New York City.  
BARTLETT, E. W., Milwaukee, Wis.  
BLAKE, C. J., Boston, Mass.  
BLITZ, A., Nashville, Tenn.  
BUCK, A. H., New York City.  
BURNETT, C. H., Philadelphia, Pa.  
DILLS, T. J., New York City.  
DODGE, S., Halifax, N. S.  
DUDLEY, D. E., Manila, Philippine Islands.  
DYER, E., Pittsburg, Pa.  
GREENE, J. ORNE, Boston, Mass.  
HAZEN, E. H., Davenport, Iowa.  
HINTON, J. H., New York City.  
HJORT, Johan, Christiania, Norway.  
HOLCOMBE, WILLIAM F., New York City.  
HOLMES, E. L., Chicago, Ill.  
HUNT, D., Boston, Mass.  
JONES, S. J., Chicago, Ill.  
KIPP, C. J., Newark, N. J.  
KNAPP, H., New York City.  
LÖWENBERG, N., Paris.  
MATHEWSON, A., Brooklyn, N. Y.  
MILLER, H. G., Providence, R. I.  
MOOS, S., Heidelberg.  
NOYES, H. D., New York City.  
NOYES, J. F., Detroit, Mich.  
PINKNEY, H., New York City.  
POLITZER, A., Vienna.



POMEROY, O. D., New York City.  
POOLEY, T. R., New York City.  
PROUT, J. S., Brooklyn, N. Y.  
RAINEY, THOMAS, Portland, Maine.  
RANKIN, WILLIAM, Newark, N. J.  
REEVE, R. A., Toronto, Canada.  
ROOSA, D. B. ST. JOHN, New York City.  
ROSEBRUGH, A. M., Toronto, Canada.  
RUSHMORE, J. D., Brooklyn, N. Y.  
SEXTON, SAMUEL, New York City.  
SINCLAIR, A. G., W. Detroit, Michigan.  
SMITH, D. B., Cleveland, Ohio.  
TURNBULL, C. S., Philadelphia, Pa.  
VERMYNE, J. J. B., New Bedford, Mass.  
VOLTOLINI, R., Breslau.  
WEBSTER, D., New York City.  
WILLIAMS, E., Cincinnati, Ohio.

## MINUTES.

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IN the spring of 1876 the following invitation was sent to certain members of the medical profession to whom it was thought that it would be of special interest:

### AMERICAN OTOLOGICAL SOCIETY.

The year 1876, being the Centennial Anniversary of the Independence of the United States of America, will be celebrated by an International Exposition in Philadelphia, and by the assembling of numerous International Congresses, among others of an International Medical Congress in Philadelphia, and of the International Ophthalmological Congress in New York. Believing that these events will bring to this country a number of gentlemen who take an active interest in Otology, and being desirous of taking advantage of this favorable opportunity for the institution of an International Otological Congress, the American Otological Society has deemed it expedient not only to hold its own annual meeting in New York City, on Friday, September 15, but also to issue a call for the assemblage of an International Congress on the same day directly after the probable adjournment of the Ophthalmological Congress.

You are therefore respectfully invited to meet the members of the American Otological Society, in New York City, at 10 A. M., of September 15, 1876, for the purpose of instituting and carrying on an International Congress of Otology.

Members of the medical profession who take an active interest in Otology will also be invited, through the medium of the medical press of this and other countries, to attend this Congress, but your services in this department of medical science have led us to specially invite you to be present and to furnish a paper on some subject in Otology.

A reply to any member of our committee on or before May 15, 1876, will facilitate the efforts to make complete and pleasant arrangements for the reception of delegates.

D. B. ST. J. ROOSA,  
20 East Thirtieth Street, New York, N. Y.

CLARENCE J. BLAKE,  
*Hotel Berkeley, Boston, Mass.*

HERMAN KNAPP,  
25 West Twenty-fourth Street, New York, N. Y.

J. ORNE GREEN,  
12 Beacon Street, Boston, Mass.

The suggestion therein contained was carried out, and at noon on the 15th of September, 1876, under the lead of the American Otological Society, the International Otological Society was organized.

A committee composed of Drs. H. Knapp, C. J. Blake, and H. Pinkney was appointed by Dr. Roosa, the retiring President of the American Otological Society, to report a plan of organization. Subsequently, Dr. Knapp reported a draft of a constitution, which, after receiving slight alterations, was adopted as follows :

#### CONSTITUTION OF THE INTERNATIONAL OTOLOGICAL SOCIETY.

1. The name of this society shall be the International Otological Society.

2. The object of this society shall be the promotion of otological science and the advancement of independent observation and research in subjects pertaining thereto.

3. The number of members is unlimited.

4. Only doctors of medicine, surgery, or science, or persons possessed of an equivalent degree, or distinguished for scientific attainments, shall be eligible for membership.

5. Candidates for membership shall be admitted on presentation of their diplomas, or titles, or by ballot. Five members may demand a ballot in any case.

6. The session of the congress shall be held once in every four years.

7. Before the close of each meeting, the congress shall determine the place of next meeting and appoint a provisional committee with full power to make all necessary arrangements; this power shall end at the opening of the next congress.

8. The officers shall consist of a President, two Vice-Presidents, a Secretary who shall also be the Treasurer, and a Corresponding and Assistant Secretary, forming a Board of Direction.

9. The President shall direct debate and maintain order at the meetings, and with the assistance of other members of the Board of Direction shall determine the hours of meeting and the order of proceedings.

10. The Secretary-Treasurer shall keep and read the record of proceedings and correspondence; shall receive subscriptions, and on payment thereof shall issue cards of membership, signed by the President and Secretary.

11. The amount of subscription shall be determined for each session. Payment of the subscription entitles a member to admission to all meetings of the session, and to a printed copy of the minutes and other publications of the congress for that session.

12. The archives of the society shall include only communications in-

tended to be printed, minutes of the meetings, decisions of the society, and correspondence. All other communications and objects presented to the society by its members shall be returned to them at the end of the session.

The archives and funds of the society shall be in charge of the Secretary, who, at the close of each session, shall transmit them to the Secretary appointed for the next session.

13. The decisions of the society shall be taken *vivâ voce*—a ballot may be demanded by five members.

14. The following order of business shall be observed in each session, unless otherwise decided by a majority of members present :

1. Reading of minutes of preceding session by the Secretary.
2. Election of members and appointment of committees.
3. Reading of correspondence.
4. Reading of reports presented to the society.
5. Presentation of papers.
6. Presentation of apparatus or specimens.
7. Verbal communications.
8. Determination of the order of the day for the following meeting.

15. After the reading and discussion of each paper presented, the society shall decide as to whether it shall be referred to the publishing committee.

16. The above rules may be altered or annulled by a majority consisting of two thirds of the members present.

The committee further reported by advising that, as a basis of organization, all members of the American Otological Society present, or who had signed the register of the International Otological Society, be admitted to membership without ballot. Adopted.

The committee then presented a list of officers to be elected by ballot, in which all those who had registered were invited to join. The following were declared duly elected: D. B. St. John Roosa, M. D., New York City, President; E. L. Holmes, M. D., Chicago, Ills., 1st Vice-President; A. H. Buck, M. D., New York City, 2d Vice-President; J. S. Prout, M. D., Brooklyn, N. Y., Secretary and Treasurer; C. J. Kipp, M. D., Newark, N. J., Corresponding and Assistant Secretary.

A committee on business and membership was then appointed composed of Drs. C. H. Burnett, C. J. Blake, and S. J. Jones, after which the society adjourned for one hour.

On reassembling, this committee reported that the following members of the American Otological Society were entitled to admission as members, which report was adopted: Drs. D. B. St. John Roosa, New York City; J. H. Hinton, New York City; O. D. Pomeroy, New York City; David Webster, New York City; Hermann Knapp, New York City; Thomas R. Pooley, New York City; A. H. Buck, New York City; Howard Pinkney, New York City; Samuel Sexton, New York City; C. R. Agnew, New York City; Henry D. Noyes, New York City; Arthur Mathewson, Brooklyn, N. Y.; J. S. Prout, Brooklyn, N. Y.; John D. Rushmore, Brooklyn, N. Y.; E. Dyer, Pittsburg, Pa.; Charles H. Burnett, Philadelphia, Pa.; E. Williams, Cincinnati, Ohio; J. J. B. Vermyne, New Bedford, Mass.; C. J. Blake, Boston, Mass.; J. Orne Green, Boston, Mass.; Samuel J. Jones, Chicago, Ills.; E. L. Holmes, Chicago, Ills.; Horace G. Miller, Providence, R. I.; Charles J. Kipp, Newark, N. J.; William Rankin, Jr., Newark, N. J.; J. F. Noyes, Detroit, Mich.; E. W. Bartlett, Milwaukee, Wis.

The following gentlemen were then, on the nomination of the committee, elected members: Drs. A. Alt, New York City; William F. Holcombe, New York City; T. J. Dills, New York City; David Hunt, Boston, Mass.; Charles S. Turnbull, Philadelphia, Pa.; Johan Hjort, Christiania, Norway; E. H. Hazen, Davenport, Iowa; Richard A. Reeve, Toronto, Canada; A. M. Rosebrugh, Toronto, Canada; A. Blitz, Nashville, Tenn.; David E. Dudley, Manila, Philippine Islands; D. B. Smith, Cleveland, Ohio; Thomas Rainey, Portland, Maine; S. Dodge, Halifax, N. S.; A. G. Sinclair, Detroit, Mich.

Subsequently, on motion, Professors R. Voltolini, of Breslaw, A. Politzer, Vienna, S. Moos, Heidelberg, and Dr. N. Löwenberg, Paris, were elected members.

The Business Committee reported, recommending an assessment of five dollars on each member, for the purpose of raising funds to defray the expenses of the present meeting of the society, on payment of which each member shall receive a card of membership and shall be entitled to a copy of the transactions of this meeting and other publications of the society. Adopted.



The committee further recommended the appointment of the following publication committee: Drs. Arthur Mathewson and J. D. Rushmore, together with the Secretary and Assistant Secretary. Adopted.

The following list of papers was also reported by the same committee, some of which were read in full, some in abstract, and others by title. There was time for very little discussion on any of them:

1. A Case of *Aspergillus* in the Tympanic Cavity. C. H. Burnett, M. D.
2. On Primary Periostitis of the Mastoid Process. H. Knapp, M. D.
3. Certain Modifications of the Usual Methods of Treatment of Chronic Non-Suppurative Inflammation of the Middle Ear. S. J. Jones, M. D.
4. A Case of Exostosis of the External Meatus operated on by the Dental Lathe. Dr. A. Mathewson.
5. A Case of Plastic Operation on the Auricle. Dr. A. Mathewson.
6. Test-Sentences for determining the Hearing Power. A. H. Buck, M. D.
7. Two Cases of Acute Inflammation of the Membrane of Schrapnell. A. H. Buck, M. D.
8. A Sketch of the Early Development of the Ear with a New Account of the Development of the Meatus Auditorius Externus, Membrana Tympani, and Middle Ear. D. Hunt, M. D.
9. Hyperostosis of the Mastoid. J. Orne Green, M. D.
10. On Gaseous Interchange in the Tympanic Cavity, Physiological Considerations, and Therapeutic Applications. N. Löwenberg, Paris.
11. A Case of Abscess over the Mastoid Region, extending to the Squamous Portion of the Temporal Bone and involving the Brain without Harm to the Auditory Apparatus. O. D. Pomeroy, M. D.
12. Paper Dressings for Perforations of the Membrana Tympani. C. J. Blake, M. D.
13. Remarkable Case of Vertigo, following an Injury of the Middle Ear. E. L. Holmes, M. D.
14. Perforation of the Membrana Tympani with no Premonitory Symptom. E. L. Holmes, M. D.
15. On Syphilitic Disease of the Labyrinth. D. B. St. John Roosa, M. D.
16. Report on Progress of Otology, prepared for the American Otolological Society. Drs. C. H. Burnett, of Philadelphia, and C. J. Blake, of Boston.

Dr. Knapp from the Committee on Organization introduced the following resolution, which was adopted:

That the place of the next meeting of the International Otological Society shall be that of the next meeting of the International Ophthalmological Congress. The provisional committee to make the necessary arrangements for the meeting shall consist of the following gentlemen: Prof. R. Voltolini, Chairman, Prof. A. Politzer, Prof. S. Moos, Secretary, and Dr. N. Löwenberg.

There being no further business, the President thanked the society for the honor they had conferred upon him, and for the patience with which they had submitted to rulings which were necessarily peremptory, from the very limited time at their disposal. He ventured the hope that the next congress might assemble on the plateau of Heidelberg Castle, and that many of those now present would be at that meeting.

The congress then adjourned, to meet again in 1880 at the call of the provisional committee.

# REPORT ON THE PROGRESS OF OTOLOGY, 1875-1876.

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## PART I.

### *Anatomy and Physiology.*

By CHARLES H. BURNETT, M. D., Philadelphia.

DR. URBANTSCHITSCH has reported the following interesting case of peculiar epithelial formation on the membrana tympani:

A physician in Vienna consulted him for a purulent otitis externa diffusa. The examination revealed a perforation of the membrana tympani in the under segment. The case was treated with astringents, and in two months all purulent symptoms disappeared.

A month later, the disease in the external canal had entirely gone, but the drum-head, which was in the main entirely normal, showed here and there several shining, white, and well-defined deposits, as though it were set with small pearls at these points.

A second case with similar appearances was observed by Dr. Urbantschitsch in a man fifty years old. Touching these bodies with a probe revealed that they were very hard, and a tenotome was with difficulty pushed through them. Portions of these growths, examined under the microscope, revealed the presence of epithelium only. Cholesterine was absent, as shown by the microscope, and by chemical tests of sulphuric acid and iodine.

The first-mentioned case was examined by Dr. Urban-

tschitsch in January, 1875, two years after the last examination, and it was found the growths had disappeared entirely, without any form of treatment.

In a third case, somewhat similar bodies were observed behind and parallel with the manubrium. There were three in all, one of which in the course of a month had disappeared, while the other two were still there, slightly larger than before, but retaining their characteristic pearl-like appearances.

According to Zaufal's researches it appears that Voltolini, 1861, was the first to publish any account of observing during life the tubal ridge (*Tubenwulst*) through the intact nose.

In 1873, Dr. C. Michel published a paper, entitled "The Relation of the Tubal Mouth to the Soft Palate, as seen through the Nose of the Living Subject."

In 1874-'75, Dr. Zaufal's own elaborate papers on this topic were published. In an article, entitled "The Normal Movements of the Pharyngeal Mouth of the Eustachian Tube," Dr. Zaufal gives an historical sketch of the observations of this part of the body, which have been made on the living subject.

Bidder, 1838, appears to have been the first, and his observations were corroborated by Schuh in 1858. These studies related chiefly to the soft palate, but it is also evident from their statements that these observers saw the pharyngeal mouth of the Eustachian tube.

Zuckermandl has described a pouch-like cavity on the outer wall of the pharyngo-nasal space, to which he gives the name of *Recessus salpingo-pharyngeus*. He found this anomaly on both sides of the pharynx, in the body of a man twenty years old. In ten skulls examined, Zuckermandl found this anomaly more or less developed, on the left side twice, once on the right, and four times on both sides.

Michel has made some recent observations of the condition of the pharyngeal mouth of the Eustachian tube, and also on the function of the muscular structures of the pharynx. He had the opportunity of studying these structures in their natural state in the person of a man twenty years old, who had lost the entire contents, bones, etc., of the nose. The ob-

server could see the entire nasal cavity, and the naso-pharyngeal space at a glance, thus taking in at one time the whole tract from one tubal lip to the other, and from the insertion of the velum on one side to that on the other. By introducing a laryngeal mirror into the naso-pharynx the changes in the mouth of the tube were observed.

The following views were obtained:

*a.* At rest. In the bright-gray fundus of the mouth, the walls lie close upon each other, thus forming a bright-gray furrow, running from above downward, terminating on the floor in a small triangle.

*b.* When swallowing occurs, an undulation takes place in the lower part of the mouth of the tube, beginning at the side nearest the nostrils. First there is a hollowing out, then an elevation of the floor into the opening of the tube, and at the moment of the greatest elevation of the same and of the tubal lip at the height of the act of swallowing, then for the first time the tubal cleft opens. It gapes first and widest below in the shape of a black triangle, the apex of which runs out into a black line which marks the upper boundary of the tubal cleft. Immediately after the structures fall back again to their position, and the wide cleft, which is not always of the same dimensions, disappears, and the fundus of the mouth of the tube is again bright gray in appearance.

*c.* Phonation. During phonation the posterior tubal wall is uniformly moved backward, pushed away and up from the anterior wall of the canal, by the wedging in between them of the floor of the mouth of the tube. Only in singing a high *i*, or *e* (German), does the floor of the canal rise so high as to cause the cleft of the tube to become so narrow as to obliterate the triangle which usually appears at an ordinary act of swallowing.

At such a time the tubal ridge (cartilage) and the velum are thrown into such lively vibrations, that one can easily see how these motions can be conveyed to the bony tympanic cavity and become the cause for the humming and buzzing experienced in the ear when *i* is sounded loudly and held.

The cracking noise heard on swallowing may also be partly accounted for by the movement of the tubal cartilage.—(See review by Zaufal, *Archives of Otology*, vol. xi., pp. 61, 62.)



Prof. Rüdinger's observations on the individual differences in the size of the jugular fossa have been conducted upon the skulls of one hundred and two adults (men, chimpanzees, and gorillas). The results are that seventy times the jugular foramen was larger on the right side, twenty-seven times on the left; only four in one hundred human skulls presented equal openings on each side. The least difference was one millimetre; the largest, sixteen millimetres. The conclusions are: 1. Both jugular foramina are, in their normal state, unequally broad and deep. 2. This difference in size is neither the result of a malformation nor of an osseous or suture-change in the petrous part of the temporal bone and its surroundings. 3. The difference in size is the result of the peculiar condition of the sinus of the dura mater, which depends upon the variable quantity of blood, flowing on one side from the surface of the brain, and on the other from the cavities of the brain. 4. The wide fossa jugularis on the pars petrosa appears to be an individual peculiarity, which interferes neither with the circulation of the blood within the cavity of the skull nor with the functions of the organ of hearing.

Prof. Gruber has found in a temporal bone in his cabinet a rare anomaly, consisting in a deficiency in the bone, extending from the jugular foramen upward and backward. This opening is of irregular oval shape, one cm. long by three-quarters of a cm. wide, and lies between the styloid process and mastoid incisure. Its irregular edge would seem to indicate that it was not a passage-way for a blood-vessel, but, rather, that it is purely a pathological process. The most important consideration is that the sinus beneath it was covered only by soft parts, and an ordinary incision with a bistoury for the opening of a deep abscess beneath the mastoid process might have penetrated the sinus.

Urbantschitsch has pointed out some variations in shape and position in the pharyngeal mouth of the Eustachian tube of man. There may be great differences at these points in the same person, as well as in those of the same age. These differences are found only in the lower ends of the cartilaginous walls of the tube. These walls may form at the mouth of the tube, and only there, acute, right, or obtuse angles with each

other, or the anterior wall may be a mere button-like projection from the posterior wall. Be it remembered that the variations are found only in the cartilage of the tube at its pharyngeal end; above this point, a transverse section of the canal *always* reveals the well-known shape of a shepherd's crook.

These differences may, however, influence the shape of the pharyngeal mouth of the Eustachian tube. In some cases, the shape and position of the membranous part of the anterior wall of the tube influence the calibre of the canal. The variations in this part of the tube may be in the form of an elevation or a depression, and are due to irregularities in the position of the inner lamella of the pterygoid process of the sphenoid bone, which sometimes ends immediately at the lateral, i. e., anterior cartilage of the tube; but in others extends further backward and downward.

In the first instance, the membranous tube sinks forward into the pterygoid fossa, while in the second instance the unusually low-descending lamella produces a prominence in the membranous tube. As a rule, the pharyngeal mouth is shaped like a pear, its base being sometimes upward, in other cases downward. In some individuals the ostium pharyngeum is kidney-shaped. These deviations in shape are, according to our author, due to the ligamentum salpingo-palatinum of Zuckerkandl, which runs from the anterior wall of the tube to the palate. To these fibres, according to Urbantschitsch, a series of fibres runs forward from the ligamentum salpingo-pharyngeum, which arises from the under end of the inner or posterior cartilaginous wall of the tube, and the two sets modify the shape of the mouth of the tube. Zuckerkandl, having had an opportunity of examining the Eustachian tube of an elephant twenty-six years old, the petrous portion of which had, unfortunately, been destroyed, gives, however, some interesting comparative points of difference in the cartilaginous or pharyngeal part of this animal's tube. The naso-pharyngeal space is comparatively small. The ostium pharyngeum is not found by ordinary inspection, as its position is not marked by any anatomical prominence. Careful search must be made for it, when the course of the tube will be found to be nearly at right angles toward the tympanic cavity. The length

of the entire tube is fifteen cm., as the portion of it which our author examined was ten cm. long, and was, in his opinion, about two-thirds of the entire Eustachian tube. The mucous membrane of the pharyngeal portion of the tube is smooth and the glands near the pharynx are sparse. The chief peculiarity in the elephant's tube is, that its os pharyngeum has no marked cartilaginous boundary. Near the pharyngeal mouth, the anterior wall of the tube is thicker than the posterior, and the former projects into the pharynx, which is just the reverse of what it is in man.

The anterior wall grows thinner and the posterior wall thicker as they approach the tympanum. The posterior wall is also partly membranous, like the anterior wall. The entire tube is attached only very slightly to the base of the skull by the basilar fibro-cartilage; the latter scarcely touching the posterior or medial wall of the tube. The microscopic appearances of the tube in the elephant are very interesting, since the only special and homogeneous cartilaginous structure in it is the (*Tubenkuppel*) dome-like roof, which is shared equally by each wall, i. e., it is a furrow formed equally by the outer and inner wall. The rest of the tubal cartilage, by far the greater part of it, contains three kinds of cartilaginous structures. In the more fibrous structure representing the body of the mass is found a cartilaginous network, with variable mesh, here and there connected with the dome of the tube, and, like the latter, resembling hyaline cartilage. The peripheral portions of this network are surrounded by dazzling white and softer lines, which form in some transverse sections of the tube small, independent islands. These latter are patches of calcified connective-tissue cartilage, with few cells. Between the aforesaid tissues, those parts not entirely surrounded by white boundaries are reddish-yellow in color, dense, of a fibrous appearance, and not so resistant as the hyaline tissue.

Prof. Lucæ has added greatly to our knowledge of the relation of the soft palate to the pharyngeal mouth of the Eustachian tube, both at rest and in motion, by direct observation of these parts in the person of a man seventy years old, who had lost all the cartilaginous and bony external nose by lupus.

In this case, without any artificial light, the naso-pharynx and velum were studied. The observations correspond closely with those of Michel<sup>1</sup> and Zaufal.<sup>2</sup> The hearing in the man examined was perfect, his hard and soft palate, palatine arches, and uvula were normal. The motions of the soft palate and of the well-formed tongue were also normal, and the respiration was strong and deep. His speech was strong and sonorous, swallowing was performed normally, and his sense of smell was extremely sharp. The hearing, for whisper, amounted to eight feet on the right side and twelve feet on the left. Both drum-heads were slightly opaque and bluish in color; the pyramid of light was fainter on the right side than on the left.

The destruction of the anterior portion of the external nose being so extensive, direct inspection of the naso-pharyngeal space and mouth of the Eustachian tube revealed the following: Quiet breathing usually produces no marked change in the pharyngeal mouth of the tubes; the opening of them, however, at such a time, is seen to be entirely free, but how far such a patulence extends up the tube it is impossible to say, since nothing more than a profile view could be obtained. A very different appearance of these parts is brought about by phonation, aspiration, swallowing, and deep inspiration. All of these acts, especially the prolonged phonation of the vowel *a* (German) broad, cause the velum palati to spring quickly upward and assume an horizontal position, so that its free posterior edge touches more or less firmly the posterior pharyngeal wall, and its upper, i. e., posterior surface comes to be about in the plane of the floor of the nose. At the same time, it was seen that the lower part of the prominent posterior lip of the mouth of the Eustachian tube was drawn upward, backward, and inward, away from the anterior lip, which remained essentially unaltered in position, and the former was thereby made to approach the posterior wall of the pharynx. Into the triangular space thus formed at the mouth of the tube, the hinder surface of the velum palati (levator-ridge of Zaufal) forces itself in, so that, at the moment of greatest ele-

<sup>1</sup> *Berlin. klin. Wochenschr.*, 1873, No. 34.

<sup>2</sup> *Archiv für Ohrenheilkunde*, Band ix., S. 133 and 228.



vation, the ambilateral changes of position in the tubes form with the velum palati an appearance of a half moon, convex upward, the sloping points of which are received by the mouths of tubes.

The first fact learned by the observation of this case teaches that the mouth of the tube is widened in a direction backward and inward, but narrowed from above downward, during the acts named. The question whether the united effect of both these motions brings about an opening or a closure of the mouth of the tube is next considered. By his observation of the case alluded to, Prof. Lucæ is convinced that the mouth of the tube is narrowed, i. e., closed, by swallowing and phonation, which is in accord with the views of Michel. By placing a few drops of water in the mouth of the Eustachian tube of the patient, it was seen that every act of phonation or swallowing caused the water to flow from the mouth of the tube into the pharynx and nostril, which result tends to prove that the tube was closed rather than opened by these acts, for, were it opened thereby, the water would have run backward into the tube and not out into the pharynx and nose. This closure of the tube seemed to extend about one and a half cm.

Prof. Lucæ next considers the objective investigations on which rests the theory that the tube is opened by swallowing. 1. The opinions respecting the function of the tensor palati mollis, as set forth by Valsalva and Rüdinger, are now held by most authors, viz., that it is a dilator of the tube. 2. The functions of the levator palati mollis are not so clearly defined, and the opinions on the subject are very diverse. The most general opinion, however, respecting this muscle, is, that when it contracts it must narrow the mouth of the tube. This narrowing, and consequent compression of the air, is so marked that it may bring about a positive oscillation in the air of the tympanic cavity, which is especially well seen by a bulging of the membrana tympani in cases of its partial atrophy and consequent abnormal mobility. Therefore, the levator palati is considered, so far as concerns its relations to the tube, as an antagonist of the tensor palati, which is the view of Tortual, Von Tröltsch, Politzer, *et al.*



In swallowing, it is conceded that the levator palati lifts the soft palate and narrows the mouth of the tube; functions fully shown by the observations of Michel and others.

Concerning the tensor palati, Prof. Lucæ thinks it has not yet been proven that it opens the tube during swallowing, but he thinks it highly probable that "this muscle, right after the completed act of swallowing, participates in the reopening of the tube, occurring simultaneously with the cessation of the action of the levator palati and the sinking back of the velum."

Prof. Lucæ then shows, by manometric experiments on persons with pervious tubes but perforated drum-heads, that the first effect of swallowing, phonation, forced respiration, and aspiration, is to cause a positive oscillation in the manometric column. This is due "to the composite atmospheric oscillation which occurs in the naso-pharynx by the elevation of the velum, and extends to the ear through the tubes."

Although Prof. Lucæ proposes these explanations for what he terms error in the previous view concerning the mechanism of the tube, he does not deny that, during the act of swallowing, the tubal muscles bring about a physiological ventilation of the ear. This ventilation of the ear is not brought about, according to this observer, by the opening of the usually closed tube, at swallowing, but by the fact that the usually patulous mouth of the quite loosely closed membranous-cartilaginous tube is powerfully compressed by swallowing, and after the act is opened again.

The practical deductions drawn from these studies by Prof. Lucæ are: That we may blow air into the middle ear by employing a movement which will cause the velum palati to hermetically close the naso-pharyngeal space. Such a process may be effected by prolonged phonation of the vowel *a*, which will cause the velum to rise, cut off the upper from the lower pharynx, and during this act air may be blown into the nares, and thence into the middle ear, by a powerful inflation with the hand-balloon.

Prof. Lucæ considers, both theoretically and experimentally, the question whether "the Eustachian tube is usually

hermetically or only loosely closed?" and arrives at a conclusion in favor of the latter.

He describes an experiment on a glass model of the auditory apparatus, a diagram of which accompanies his paper, which seemed to prove that, if an equal pressure of air be conveyed to the external auditory canal and the Eustachian tube, from the same source and at the same time, both passages being equally patulous, the vibrations of the drum-head will be unrecognizable, i. e., practically, the *membrana tympani* will remain at rest.

If, however, the Eustachian tube, in the glass model, be lightly stopped at the isthmus with cotton wadding, then, if pressure from the same source be conveyed at the same time to each side of the *membrana tympani*, the slight hinderance afforded by the cotton to that part of the air going into the Eustachian tube will allow a preponderance of that column of air entering the external auditory canal.

Some such analogous process occurs during a wave of sound, which enters the auditory canal with less obstruction than it meets in the roundabout way it has to go to enter the Eustachian tube. The sound-wave reaches the latter through the nose and naso-pharynx in a weakened condition.

This preponderance of the column of air entering the external auditory canal is best seen in regular periodic vibrations. If we pass from these to a constant pressure of air, conveyed to each side of the drum-head by the way of both external auditory canal and Eustachian tube, we shall find that the preponderance of the air entering the former passage is gradually lost, and that the *membrana tympani* returns to and remains in its normal position of equilibrium, because the slight resistance offered to periodic vibrations by the wad of cotton in the tube is overcome by constant atmospheric pressure.

From these physical experiments Prof. Lucæ passes to observations on the living subject.

The apparent incompleteness of the auditory apparatus, resulting from the lax closure of the Eustachian tube, is amply compensated for, according to this observer, by the renewal of air in the tympanic cavity, not only by swallowing but by respiration.

The latter function is thus explained by Prof. Lucæ: If the membrana tympani of a person of normal hearing be examined during the act of blowing the nose, which is an act midway between ordinary expiration and the Valsalvan inflation, the membrane will be seen to move very distinctly, without any simultaneous act of swallowing. Further, if the membrana tympani of a person of normal hearing be examined while his head is firmly fixed, it will be seen that, at each expiratory impulse produced by blowing the nose, the membrana tympani will bulge, especially at the upper and hinder quadrant. It will also be observed that, with the cessation of this expiratory effort, the membrana tympani will return, without any act of swallowing, to its normal position with more or less rapidity.

The conclusions reached by this observer are, that the Eustachian tube is not to be regarded as a usually completely open tube, nor must we consider it an hermetically closed one. "It is, rather, a *loosely closed* tube, which is opened with more or less ease, according to individual peculiarities, by fluctuations of atmospheric pressure in the naso-pharynx and the tympanic cavity," which theory, according to Prof. Lucæ, is perfectly tenable in view of the acoustic theory of audition, as well as in harmony with the experiments just alluded to.

After the removal of a large tumor from, and a portion of, the right superior maxilla of a man twenty-three years old, Nicoladoni was able to observe by direct inspection the movements of the mouth of the left Eustachian tube.

This observer says: "Simultaneously with the contact of the soft palate with the posterior wall of the pharynx, whereby the hinder surface of the velum lay almost in the same plane with the floor of the nares, the median or posterior wall of the tube, one cm. high, began its movement while the anterior or lateral wall apparently remained still. The rather rapid motion of this part consisted in the backward and slightly inward movement of the under prominent edge of the medial plate of the tube, three millimetres from its position of rest; at the same time, the lower boundary of the fossa of Rosenmüller became tightly stretched, and assumed the form of a salpingo-pharyngeal arch, with an oblique plane,

projecting like a screen (*coulissenartig*) into the pharyngeal space." The top or roof of the tube remained still.

From the results gained in this case, by injection of salicylic acid into the wound, and mediately into the tympanic cavity, it appears that this acid had a cauterizing effect on the mucous membrane of the drum-cavity, and care is advised respecting the use of the alcoholic solution of salicylic acid in fresh cases of inflammation of the middle ear with perforation of the drum-head.

In chronic purulent discharge from the middle ear, Nicoladoni has found that usually the use of the alcoholic solution of this acid will bring about a diminution, and in some cases a cure, of the disease.

Allusion is made by the author to the views of Thiersch (*Journal f. pract. Chemie*, Bd. x., and *Volkmann's Sammlung klin. Vorträge*, Nos. 84, 85), according to whom, "Salicylic acid favors the cicatrization of granular surfaces, and, if a watery solution of salicylic acid is poured over a wound, a white layer of coagulum is formed by precipitation of the albuminates from the serum of the pus." The author concludes his interesting paper by an exhortation to a thorough trial on all sides of the effects of salicylic acid in aural disease.

W. Flemming, of Prague, offers the results of some interesting subjective observations and experiments upon his own Eustachian tube. After alluding to the observations of Poorten, Rüdinger, and Yule, with all of whom he agrees in the main, that the normal condition of the tube at rest is closed, he gives the following reasons for his conclusions:

During a Valsalvan inflation of the tympanic cavity, a simultaneous humming of a note, on the part of the experimenter, will be heard as a peculiar bell-like, droning sound. If it is supposed that before the Valsalvan inflation the tube was closed, but by the impressed air is forced open, then, of course, the explanation of the peculiar sound is not difficult; the strong autophony is brought about by direct consonance of the column of air connecting the pharynx with the Eustachian tube and middle ear.

If, on the other hand, it is supposed that the tube is always



open, then an explanation of the above-named sound on inflation, by Valsalva's method, must be looked for in the increased tension of the drum-head by the augmented intra-tympanic pressure.

This latter explanation is, in the opinion of Prof. Fleming, entirely inadmissible, for the following reasons :

1. On account of the several cases of apparent continued patulence of the tube, and the consequent autophony, observed by Poorten, Rüdinger, and Yule, upon themselves.

2. Similar results as to autophony, produced by the patulence of the tube, kept up by the use of the catheter, on others.

Our author states that he has been able, ever since childhood, to voluntarily open his Eustachian tube by certain muscular efforts, in a way which he cannot accurately explain. This action is not at all like the act of swallowing, and can be carried out whether nose and mouth are closed or opened, during inspiration, expiration, or during a pause in respiration, and upon one side at a time, or on both sides.

When free from catarrh the tube can be thus held open several minutes, during which time each inspiration and expiration can be heard as a loud, roaring sound.

When the tongue is depressed for the purpose of examining the pharynx, this peculiar act is performed easily only during expiration. It can be done with great difficulty, however, during inspiration, but the tube cannot at such a time be held open. This muscular act is always accompanied by the well-known cracking in the ear, which is always a little in advance of the opening of the tube.

The sensation in the drum and the resonance perceived upon phonation, whenever this voluntary act on the part of the author is carried out, are unmistakably and completely identical with those brought about in him by the Valsalvan inflation, and a simultaneous act of phonation. It is fair to conclude, then, that their cause is the same. But this cause cannot lie in an increase of intra-tympanic pressure and tension of the drum-head, for in the case just narrated such a condition of pressure cannot exist, since both mouth and nose are open. The author, therefore, says : " Whoever continues

to hold that the tube is normally always open must give another explanation of the resonance produced by the Valsalvan act of inflation."

A curious case of abnormal development, dignathia, or double-jaws, has been observed in a lamb and carefully described by Rosciszewski, of Warsaw. Dignathia is thus defined by Gurlt: "On one side of the normal under-jaw or in the neighborhood of the ear, there is found a second under-jaw, which is either nearly perfect or very imperfect. In the first case the accessory under-jaw is united on its side of contact with the normal jaw; in other cases both are merely held together by soft tissues, and by a tongue which is single at its root but double at its tip. In every instance dignathia depends on the existence of an accessory under-jaw."

The malformation described by our author was found on the left side of the head of a lamb at the spot where the porus acusticus externus usually lies. At this point there was found a cleft eleven mm. long, running obliquely from without and above, downward and inward, and connecting by means of a canal, twenty-six mm. long, with the pharynx. The inner mouth of this malformed canal has the appearance of a narrower cleft than the outer. This canal, which connects these two openings, occupies the place of the cavity of the tympanum and the Eustachian tube. The malformed opening of the external ear is bounded by the edge of the auricle, and anteriorly by the half of an accessory under-jaw, with lip, four incisor teeth, and a part of the accessory tongue. The length of this accessory jaw was forty mm., its breadth, in the middle, ten mm.

This peculiarly malformed external opening for the ear, thus transformed into an accessory mouth, is lined with mucous membrane. The malleus and anvil were found behind the tube-like, soft, auditory canal, in a separate excavation, which, being on the external surface of the pyramid in the position of the so-called incudal fossa, probably represented the same. The two ossicles found in this fossa were surrounded by connective tissue. The position of the ossicles in relation to each other was entirely normal, but their anatomical structure, especially that of the anvil, was somewhat



irregular. The general form of the anvil resembled the so-called body of the anvil, inasmuch as the processes were shorter and thicker than the normal. The articular surface of the incus was perfectly normal.

The stapes could not be found, but, as the other two ossicles were found, it is supposed by the author that the stapes was destroyed in the dissection. The fenestræ were normal. The tympanic bone was attached to a fossa in front of the round window, and externally to the posterior edge of the ramus of the lower jaw, by a ligament 8 mm. long at a point 14.5 mm. from inferior maxillary articulation. On the inner surface of the petrous bone was a porus acusticus internus, covered, however, with connective tissue, and ending in the substance of the bone. The inner mouth of the Fallopiian canal was also wanting.

The four conclusions of the author are :

1. The tympanic canal represents the primitive tympanic cavity, or, in other words, the original second visceral cleft, i. e., the cleft between the first and second arches which, on one side, were transformed into a secondary mouth (throat).

2. In this transformation of osseous structures, the styloid process, the osseous Eustachian tube, and the bulla ossea, do not appear.

3. Instead of these we find supernumerary bones, the accessory under-jaw, and the accessory hyoid bone.

4. The position of the auditory ossicles outside of the malformed tympanum is explained by the fact that, in a normally developing fœtus, they are found outside of the first visceral cleft.

The accessory throat of this animal represents the primitive tympanum, and the bulla ossea, which forms later, is entirely transformed into an entirely different bone, so that the position of the ossicula auditus outside of the tympanic apparatus must be regarded as a necessary consequence of the primitive formation.

We must, therefore, conclude that the entirely irregularly formed tympanic canal, with its under-jaw and lips, represents the primitive tympanic cavity, which anomaly was brought about not by hinderance, nor yet by external mechanical forces,

nor by emotions of the mother, but according to the principles of antholysis, i. e., by a mode of development regular as to its law, but unusual as to its situation.

There were many other anomalies in this case, as may be supposed, connected with the throat-muscles and neighboring parts, which your reporter has not thought necessary to mention here further than to say that they are of interest especially to the zoölogist.

Dr. Urbantschitsch has made a series of measurements of the ossicles of hearing, and has come to the following averages:

*The Hammer.*—The length of the malleus varies between 7.0 mm. and 9.2 mm., its average being about 8.5 mm. The short process varies from 1.2 to 2.6 mm., being on the average about 1.6 mm. long. In two exceptional cases the Folian process was found to be as long as 2.5 mm. in a person thirty years old, and 5.8 mm. in a man twenty years old. The handle of the hammer, from the short process to the tip, varies from 4.2 to 5.6 mm.; average, 5.0 mm.

*The Anvil.*—The distance of the upper end of the anvil's articular surface from the free end of the horizontal ramus is from 4.8 to 6.3 mm.; average, 5.3 mm. The under articular surface is from 3.0 to 5.2 mm. distant from the anvil-stirrup joint; average, 4.6 mm.

*The Stirrup.*—The length of the stirrup amounts to 3.2 to 4.5 mm.; average, 3.7 mm. Its width, taken exactly between the two rami, varies from 1.8 to 3.5 mm.; average, 2.3 mm. Other measurements are given of various parts of the stapes and of the other ossicles. All evince a large amount of careful and accurate research, but space and time will not permit a fuller detail of them at this place.

Dr. Weber-Liel has recently published the results of his investigations concerning the functions of the membrane of the round window. These experimental investigations were conducted with a view of determining that the membrane of the round window participates directly in the waves of sound transmitted to the air of the tympanum by the membrana tympani. Johannes Müller inclined to this opinion, but the experiments of Schmiedekam and Hensen tended to decide the question the other way.

The experiments of Weber-Liel were performed on nine fresh specimens—seven from man, one from a calf, and one from a horse. The sources of sound were the human voice and three organ-pipes; the fundamental notes from the latter sources were such as gave 180, 210, and 540 vibrations per second.

The mode of conveying sound, both of organ-pipes and voice, to the prepared ears, as well as their illumination and fixation, was similar to that employed by Politzer, Buck, and Burnett.

The first results of Weber-Liel's experiments respecting the membrane of the round window were, according to his own statement, fully corroborative of those obtained by the writer of this portion of your report. But Weber-Liel then carried his observations into a further field and obtained the following results:

I. If the incudo-stapedial joint is divided and the incus pushed somewhat aside, and then the tympanic cavity hermetically closed by a firmly-inserted pane of glass (a microscopic glass cover) on the artificially-opened side, while the Eustachian tube is kept slightly open, then microscopic examination of the membrane of the round window through the glass cover reveals almost invariably that, also, under these circumstances, during the sounding of the pipes and during the singing of deeper notes, the particles of starch or the reflecting points on the membrane performed excursions which were but slightly less ( $1\frac{1}{2} : 2$ ) than those occurring before the division of the incudo-stapedial joint; these excursions, however, were observable only on certain parts of the membrana tympani secundaria. They did not occur when the cavity of the tympanum was reopened. On the head and rami of the stapes faint simultaneous vibrations were observed in two cases.

II. Upon slightly rarefying or condensing *per tubam* the air in the tympanum of the preparations arranged as above, no change was produced in the width and direction of the excursions; when the air became more condensed, the high notes first ceased to produce vibrations; with increasing condensation, the deeper notes ceased to have effect.

III. In order to exclude the possibility of the communica-

tion of sound-waves from the oval window (i. e., foot-plate of the stapes) through the labyrinth to the membrana tympani secundaria, the labyrinth was opened and the vestibule exposed from behind. After the fluid of the labyrinth had escaped, sound-waves, conducted by the membrana tympani to the labyrinth, produced no visible effect on the membrana tympani secundaria. This negative result is attributable to the loss of pressure consequent upon the escape of the labyrinth-fluid.

For, when the cochlea was sawed transversely through, and a narrow glass tube placed in the thus transversely-cut scala tympani, so that both in the tube and the scala, to which it was joined, the column of water could be elevated and depressed at will, once more pressure was brought to bear upon the labyrinth side of the membrane of the round window. Upon now closing the tympanic cavity, excursions became once more visible when the sounds of organ-pipes or the voice were conveyed to the ear.

In 1860 Politzer showed that the tensor tympani is supplied by a branch of the motor division of the fifth nerve (*Meissner's Jahresbericht*, p. 583). Lately, Voltolini ("Virchow's Archiv," Band lxx., p. 467) performed a series of experiments, which have led him to the following conclusions:

1. "Irritation (by electricity) of the trigeminus produces distinct and powerful contractions of the tensor tympani, which can be kept up for some time on the dead animal; these contractions can almost always be produced, even by weak streams of electricity."

- IV. "With some of the preparations a glass tube was cemented to the temporal bone, and through this tube (the labyrinth being undisturbed), by means of a rubber pipe, sound-vibrations were conveyed to the bones of the head. No excursions were perceptible, either with the tympanum opened or closed."

2. The same result can be obtained by irritation of the facialis, but usually only by strong electric currents, and the irritability is generally soon lost.

3. During this contraction of the tensor the drum-head is drawn strongly inward by means of the manubrium; but, of course, these excursions of the drum-head vary in different



animals; in Guinea-pigs they are so small as to be undistinguishable unless one uses an indicator, fastened to the membrana tympani.

4. During such a contraction of the tensor, and the consequent tension of the membrana tympani, a simultaneous ascent of the lymph, in an opened semicircular canal, becomes visible in the dead animal, and when the tension is removed the fluid sinks back.

5. In no instance, neither by excitation of the trigeminus nor of the facial nerve, nor even by mechanical movement of the stirrup, was a simultaneous movement in the membrana tympani secundaria visible, not even by microscopic observation of a reflection, or of an indicator attached to the membrane.

6. During irritation of the trigeminus, and the consequent contraction of the tensor tympani, there ensues a contraction of the palatal muscles, and an opening of the Eustachian tube, for the anterior membranous wall is drawn away from the posterior cartilaginous tubal ridge. The fact that the tensor tympani can be put into motion by excitation of two cerebral nerves, as above stated, may, according to Voltolini, be used as an explanation of the power the muscle has of both voluntary and involuntary movement. In one of his experiments Voltolini observed that excitation of the facial nerve produced contractions in the tensor tympani and stapedius muscles. "Such a process," says the observer, "is of the highest importance in the act of hearing, if indeed such a process occur in the living ear, which is not to be doubted; in such an event the stapedius muscle acts as a check on the movement of the hammer (*loc. cit.*, p. 479). The reflex movements of the tensor may be accounted for by the branch of the trigeminus which passes through the otic ganglion." Then arises, as Voltolini suggests, the important question, whether the fibre from the facial nerve, supplying the tensor, also passes through the otic ganglion, or goes directly from the facialis to the muscle; in the latter case the muscle would evidently possess the power of voluntary motion. Although no one has demonstrated that a branch of the facial nerve does pass directly to the tensor tympani, the muscle certainly possesses the power of vol-

untary contraction, as held by Johannes Müller, Voltolini, and others.

“Does the Chorda Tympani contain Gustatory Fibres?” —This is the title of a very interesting paper by Dr. August Carl, of Frankfort-on-the-Main.

The writer, after ample reference to the observations of others, details his own case, and the experiments performed upon his own tongue. He is twenty-four years old; was perfectly healthy until seven years old, when he was attacked by scarlatina, which was complicated by an extraordinarily severe diphtheritic inflammation of the pharynx. During his convalescence a copious discharge from both ears was observed; it soon ceased on the right side, but continued undiminished on the left side, with gradual loss of hearing.

From time to time severe attacks of inflammation occurred, with great swelling of the ear, pain, and fever, which, after lasting for a few days, gave place to a large discharge of thick, brown, exceedingly offensive pus, mixed with whitish, shining particles (cholesterine), and sometimes there appeared in the matter discharged large, coherent, membranous shreds, spotted here and there with fungi. Once or twice small, uneven sequestra came out. The present condition of the ear is said to be the following:

The drum-head is entirely destroyed, excepting a very small piece on the upper periphery. The chorda tympani is not visible. The mucous membrane on the wall of the labyrinth is cicatrized, but not markedly hypertrophied. The discharge during the last nine months has been reduced to a minimum. The hearing is so much diminished that a watch is heard only when firmly pressed on the mastoid process. A tuning-fork, placed on the sagittal suture, is heard more strongly on the left side. The function of the facial nerve is in no way disturbed. The uvula is straight. The fifth nerve is also normal. The writer, Dr. Carl, has performed experiments upon his own ear, and has recorded the following:

For several years he has noted that, in cleaning his ear with pellets of cotton held in a pair of forceps, and which were moved in all directions in the fundus of the canal, a pricking sensation in the left edge of the tongue, starting at



about the middle and running instantly to the tip. This occurred whenever the cotton swab was turned and pressed upward and forward. The same kind of sensation, though less intense, occurred whenever astringents were poured into the external auditory canal. At no time was any sensation of taste excited. The writer expresses the opinion that this sensation was the result of mechanical irritation in one instance, and in the other of chemical irritation of the chorda tympani.

"There is," says Dr. Carl, "no other nerve in this region which could be responsible for such a phenomenon, and furthermore, I believed, from this experiment, there were no gustatory fibres in the chorda, for, if its sensible fibres respond to an excitation, why should not the fibres of taste, which might be there also, reply to irritation? . . . How great was my astonishment when Prof. Fisk, my honored instructor, whom I had made acquainted with the facts of the case, in testing the anterior parts of the tongue, found complete loss of taste for everything on the left side."

In recapitulation the author says: "This is a case which presents, with a chronic destructive process confined to the tympanic cavity, a distinctly circumscribed paralysis of taste on the corresponding side of the tongue. At the same time, nevertheless, the ordinary sensibility of the tongue is not only intact, as is seen when adequate stimulation is used, but also irritation of the chorda tympani in the tympanum produces sensations on the corresponding parts of the tongue. . . . I also believe I am justified in supposing that the pathological process is, so far, confined to the cavum tympani, because there are no symptoms which point to its passage into the deeper parts of the petrous bone. The facial nerve is normal, and the inner ear retains its function, as shown by tests of tuning-fork and watch."

There have been no hæmorrhages from the ear; but Dr. Carl believes the disease of the tympanum and the paralysis of taste are not independent of each other; in fact, he thinks the latter is entirely dependent on the former. He further states that "it is absurd to suppose that a pathological process in the tympanum could have destroyed part of the fibres of

the chorda, and left the rest whole. Suppose an explanation of the process is sought in the ulceration of the mucous membrane covering the nerves which pass through the tympanic cavity, and a consequent atrophy, brought about by pressure from inspissated pus, etc., still a partial and, physiologically, a circumscribed destruction of the chorda seems impossible. And, since the sensible and secretory elements of the chorda are promptly stimulated, the natural conclusion follows that no lesion in the chorda tympani has occurred." The observer then propounds the question, "What nerves are there in the drum-cavity, the destruction of which could bring about paralysis of taste?"

And he comes to these conclusions :

"The course pursued by the gustatory fibres running from the anterior part of the tongue to the brain are, in short, as follows: They first enter the lingual branch of the trigeminus, and, while most of them, as I believe, reach the glossopharyngeus by the way of the otic ganglion, petrosus superficialis minor, tympanic plexus, and petrosal ganglion, perhaps a small amount of them, varying in individuals, pass into the chorda tympani, and thus, through the tympanic cavity, reach with the chorda the facial nerve, in the tract of which they go to the geniculate ganglion. From this point, under the name of *ramus com. nervi fac. complex. tympan.*, they are distributed to the tympanic plexus, and thus reach, a second time, the pharyngeal nerve in the tympanic cavity, in common with the first-named part, from the otic ganglion. If the tympanic plexus is destroyed, as it would seem to be from what has been said above, it becomes apparent why the chorda remained dumb respecting the sense of taste."

It seems but justice to mention here some of the objections urged by Prof. Voltolini (*M. f. O.*, No. 3, 1876) against the reliability of the observations and deductions made by Dr. Carl.

The case is a very important one, but Prof. Voltolini thinks that an error has been made in the premises, namely, that "the chorda was irritated by the cotton swab." He further states that, in his opinion, the chorda tympani has been destroyed in the diseased tympanum.

"For, if the membrana tympani is entirely gone, as it is according to Dr. Carl's statement, made, presumably, on the authority of Prof. von Tröltzsch, who is his physician, then the chorda tympani must be visible, if it be present. The hammer, too, must be destroyed, for, were it still present, Dr. Carl could not have swabbed out his ear so freely without pain. If, then, the membrana tympani and hammer are gone, and the mucous lining diseased by a chronic purulent process of seventeen years' duration, how can the chorda tympani have escaped? This were too much to suppose for so delicate a nerve."

In reply to the theory of Dr. Carl, that the loss of taste might be ascribed to the destruction of Jacobson's nerve on the promontory, Voltolini says: "This nerve is pretty well covered by lying in a relatively deep, bony groove on the promontory, and is it fair to presume that it has been destroyed, while the chorda tympani, normally lying entirely free in the tympanum, should have escaped a destruction which has invaded the membrana tympani and the malleus? . . . The destruction of the chorda tympani would account for loss of taste, just as it has in other instances. If, notwithstanding the paralysis of taste, sensation was excited when the upper edge of the annulus tympanicus, i. e., the region where the external auditory canal unites with the tympanic cavity, was touched, the case becomes simply one of reflex action."

"How this is," says Voltolini, "cannot be at once shown, but we would mention that the lingual nerve and the auriculo-temporal nerve arise from a common trunk, namely, the sensitive inferior root of the third branch of the trigeminus.

"When the auricular branch of the pneumogastric nerve is irritated in the external auditory canal, patients cough; but they do not cough because they feel a tickling in the ear, but because they feel a tickling in their throat, and yet only the auricular branch has been irritated."

Prof. Eduard Hofmann, of Innsbruck, has corroborated in the main the observations of Wendt and Wreden upon the condition of the ear in a new-born child.

In a paper entitled "Premature Respirations in their Forensic Relations," Prof. Hofmann makes these conclusions:

1. No trace of the fetal pad of mucous membrane can be found in the tympanum after the child is a few days old. The cavity of the tympanum is by that time entirely free and filled with air.

2. Purulent inflammations of the middle ear of new-born children are strikingly frequent. Wendt's theory, that such a pathological process is induced by intra-uterine respiration of amniotic fluid, is substantiated by Hofmann's dissections in so far as the constituents of meconium were found in the tympanic cavity.

A curious case of death from the effects of music was recorded by Brofferio, in 1834 (*Repertorio del Piemonte*), and has lately been rescued from oblivion by Voltolini (*Monatsschr. f. O.*, No. 5, 1875), who says that the true title of the paper should be, "Fatal Effects of Subjective Noises in the Ear," being based on the following case: "A large, robust peasant woman, twenty-eight years old, married seven years, attended a festival, where, for the first time in her life, she heard a powerful and select orchestra. The festival lasted three days, during which the woman danced a great deal, with enjoyment. After the festival was over, however, the sound of the music continued in the ears of the woman without cessation, and notwithstanding all she did for relief.

"She lost all sleep; her digestion, as well as all other functions, became deranged. No relief could be obtained by any medical efforts. She grew worse each day, night-sweats and diarrhœa set in, and the woman died in the sixth month of her misery. The noises never ceased for a moment, but grew worse each day."

Dr. Löwenberg, of Paris, has published the following results of his experiments upon the semicircular canals:

1. The disturbances in motion, which manifest themselves after the semicircular canals have been cut through, depend upon this section only, and not upon the accompanying injury to the brain.

2. Vomiting, which was noted by Czernak in his experiments, depends upon the attendant injury to the cerebellum.

3. The disturbances in motion are due to irritation of the semicircular canals, and not to a paralysis of them.



4. The irritation produces, reflectively, spasmodic paralyses, without participation of consciousness. Fresh irritations of the canals are induced only by calling forth voluntary movements.

5. The conveyance of this reflex excitation to the motor nerves occurs in the thalamus.

6. Section of the auditory nerve does not produce these disturbances of motion.

Wiedersheim has described in the "*Phyllodactylus Europæus*" a large sac, with cretaceous contents, lying on either side of the cervical vertebræ. From this double sac several canals pass upward and forward to the occiput, and, after crossing the semicircular canals, pass through small crevices, between the parietal bones and the auditory capsule, into the cranial cavity. These expand into a sac, from which there is finally a delicate canal sent through the *apertura aquæductus* into the sacculus of the vestibule.

According to Wiedersheim, the physiological significance of this ramifying system of canals is twofold:

1. He considers it a form of absorbent belonging to the lymphatic system, which, by its power of taking up the endolymph from the labyrinth, in cases of intra-labyrinthine pressure, is able to reduce the latter.

2. Wiedersheim ascribes sound-conducting functions to the sacs, and thinks that in any case the sound-waves can operate through the skin upon the cretaceous matter in the sacs, and be conducted from these to the labyrinth, without being obliged to set the resisting bones of the head in vibration.

Prof. Ranke, of Munich, makes the following very interesting communication, in a paper entitled "*True Acoustic Rods and Cells in the Ear of Mollusks:*"

In the vertebrates we find the terminal filaments of the acoustic nerve entering cylinder-cells in the labyrinth, as their specific terminal organs. These bodies, on their free end, which is turned toward the fluid of the labyrinth, either extend into a solitary, longer, and stiff acoustic rod, or in a broader surface, crowned with a wreath of shorter, stiff, acoustic rods, which gives to these acoustic terminal cells a kind of similarity to ciliated cells.

Similar acoustic terminal apparatus have not been heretofore described in invertebrates, excepting in cephalopods (*see* the admirable observations of Ph. Owsianikow and A. Kowalevsky, "Mem. de l'Académie Impériale des Sciences de St. Petersbourg," ser. vii., tome xi., No. 3). Such structures were not known to exist in the lower orders of mollusks. It was generally held, with more or less outspoken positiveness, that the ciliated cells, with movable and swinging cilia, found in the aural sac of mollusks, were real acoustic end organs in these creatures.

Helmholtz's theory of acoustic excitation demands that the acoustic nerve should terminate in stiff bodies projecting into the fluid of the labyrinth, and capable of being set into vibration by the acoustic wave-motions of this fluid.

Cilia, set in continuous motion by inherent causes, or by reflex influence, appear *a priori* unfit to act as passive vibratory acoustic apparatus. Hence arose from some quarters the doubt whether the cells in question could exercise the function ascribed to them.

Upon certain transparent species (*Pterotrachea*) of heteropods, found in the bay of Naples, the author observed, in addition to the partly very large cilia of the internal epithelium of the labyrinth-sac, which were observed in reflex motion during life, the true acoustic terminal cells, which, being cylindrical in shape, and crowned with a wreath of stiff rods, answer not only the demands of Helmholtz's theory, but suggest by their structure the acoustic cells of Corti's organ in the vertebrates. (*See* Ranke, "Der Gehörvorgang und das Gehörorgan bei *Pterotrachea*," *Zeitschr. f. wiss. Zool.*, vol. xxv., supplement.)

The spherical labyrinth-sac of these animals hangs, like a cherry on its stem, upon the long acoustic nerve. A large, round, laminated otolith floats in the labyrinthine fluid.

The internal epithelium of the aural sac consists principally of ordinary epithelial cells with large nuclei. Between these cells are ciliated cells of stellate shape, from the middle of which arises a bunch of swinging cilia, quite large, except at their ends, which terminate in delicate, whip-like ends.

These ciliated cells, at the point of entrance of the acous-



tic nerve, are sparsely arranged, but they are large, and supplied with long, thick, bristle-shaped cilia; they increase, however, in number, toward the opposite pole of the aural sac, but decrease in the size, length, and thickness of their cilia, in such regular progression, that in the more distant circuit of this pole close concentric rows of the smallest ciliated cells, with the shortest and most delicate cilia, are found. At the pole opposite to the point of entrance of the acoustic nerve, a lateral view reveals a thickening of the wall of the aural sac, including about one-sixth of the internal surface. Viewed from above, this thickening appears like a spherical disk, around which the smallest cells, just alluded to above, stand in very close circles. The round disk is the acoustic organ in the ear of the pterotrachea. Its middle point is formed of a large cylinder-cell, the broad base of which is raised above the wall of the aural sac. This is named the central or middle cell, and is crowned on its upper surface with a wreath of delicate, closely-placed and stiff rods—the *acoustic rods*. The surface of the cells looks like a horny pad, in which the acoustic rods are placed perpendicularly. Their stiff bases can be traced far into the cells. The relation of the acoustic nerve-fibres to these rods, and to the “middle cell” of the acoustic organ, is remarkable. In front of the point of entrance of the acoustic nerve the fibrillæ spread out beneath the epithelium like meridians on a globe, and run in myriads toward the acoustic organ. There they enter the “middle cell,” and it will be seen that each of the rods scattered over the surface of the cell unites with one of the finest acoustic fibrils in the cell.

It cannot, therefore, be doubted that the aforesaid stiff rods must be called the real terminal apparatus of the acoustic nerve, and the “middle cell” a true acoustic cell. The “middle cell” is divided by a relatively wide space, and surrounded by a circle of cylindrical or finger-shaped cells, of which one at least can be certainly shown to be an acoustic cell, crowned with similar acoustic rods.

This circle of acoustic cells is closely surrounded by several concentrically crowded layers of cells, which, on account of their evident connection with auditory nerve-fibrils, may

be styled a *circular ganglion*. To this the compact concentric circles of the smallest ciliated cells are attached. On fresh living specimens the stiff rods of the acoustic cells, the *acoustic rods*, can be very easily distinguished from cilia.

The acoustic rods are very transparent, uniformly cylindrical, and supplied on top either with a delicate button-like end, or with a circular terminal surface. The cilia are broad at the base, terminating above in a delicate vibratile point, and when in the fresh state are far less transparent.

The action of the cilia in the ear can be studied in the larger transparent specimens during life, without the least injury to the parts, and in the investigation comparatively high power of the microscope can be used. The aural sac lies immediately under the general surface of the body; the under-transparent portion of the animal's body acts like a thick object-glass. It will then be seen that the cilia, which, in a state of rest, lie against the inner wall of the labyrinth-sac, with their points turned toward the auditory organ, suddenly rise up, by reflex irritation, when the animal is roused by a sharp sound, and cast the otolith against the acoustic organ.

This change of place on the part of the otolith is brought about by the gradually decreasing length of the cilia in the direction of the acoustic organ; the smallest cilia, which surround most closely the acoustic organ, are placed opposite the otolith, like bumpers on the railroad-car, in order to break the force of the blow coming against the stiff, immovable acoustic rods.

These observations have been corroborated by later experiments by Prof. C. Claus, of Vienna. He, however, believes that the small ciliated cells which closely surround the acoustic organ are also true acoustic cells, but this view is not based on observation of the animal in life.

Dr. Hermann Dennert has written an article of the greatest importance respecting testing hearing in cases of unilateral destruction of the cochlea.

He thinks that there must have been some error of observation in those cases of destruction of the cochlea, recently reported as retaining hearing on the affected side. He inclines to the opinion of Schwartze that "the probable cause of

the error in these cases lies in the impossibility of complete exclusion of the perfect ear from participating in the hearing of the tests employed."

In the consideration of this subject two points must be borne in mind: 1. Whether a process which destroys the cochlea would leave the structures of the vestibule so far intact as to be able to perceive sound; and, 2. How far these structures, in any case, are concerned in the act of hearing, especially in the perception of speech.

A discussion of such a point the author considers desirable, because an endeavor has been made of late to define the consonants as sounds having fundamental notes with a given pitch; and then, in accordance with the present theory of the function of the cochlea, to ascribe to the latter alone the understanding of speech. The writer then states his views on the mode of hearing in general thus: "We shall not, perhaps, be wrong in supposing that we hear all sounds with the structures of the vestibule, but indistinctly and with undecided limits; the co-operation of the cochlea gives to that which is heard its finer shades, form, etc. We *hear* with the vestibule; we *understand* with the cochlea."

He further states that he is of the opinion that the entire mechanism, from the drum-head to the stirrup, is of importance, chiefly in respect to the acoustic processes in the vestibule, in which, at every in-and-out movement of the stirrup, the vestibular contents are excited summarily as a whole, since the sound-waves as motor forces operate mechanically against the drum-head, as on a plane surface, while in the cochlea the musical tones are immediately taken up. At a future time the author proposes to publish further views on this point.

He does not believe that speech is a simple musical process, and he gives the following reasons: "We often find, in testing hearing, that the perception of speech does not stand in a proportionate relation to the perception of musical notes; further, the improvement which occurs upon using the catheter, or the application of the artificial drum-head, is not always equal for both.

"Again, a number of words, especially those in which a number of consonants occur, remind one so strongly of noises,

that it is difficult to draw a line between a word composed of tones and a noise. Hence it would be necessary to resolve every perceived sound in the cochlea, a supposition against which the occurrence of vestibular structures in animals without a cochlea would necessarily militate."

He therefore concludes that a perfect coöperation of vestibule and cochlea is necessary for perfect hearing, and he also thinks that those cases have been incorrectly observed in which, though the cochlea is lost, hearing was said to be good, *and that the apparent hearing in the diseased ear is due to the perception of sound in the good ear.* This he has conclusively proved by a case recently observed in the clinic of Prof. Lucæ, of Berlin. Without giving the particulars, it is only necessary to state that Dr. Dennert removed from the right auditory canal of a boy, seven years old, a sequestrum, which on examination proved to be the entire cochlea, with a part of the vestibule. The hearing, tested immediately after the removal of the cochlea, as well as repeatedly afterward, always gave the same result. The boy, with his good ear firmly stopped, heard most of the numerals repeated in a loud whisper near the affected ear; he also heard ordinary words spoken in moderate tones. He did not hear the ticking of a watch pressed close on the diseased ear, nor did he hear it when the watch was pressed on the mastoid process, nor on the temple. Notes of tuning-forks of various pitch were not perceived, neither with nor without resonators. If the tuning-forks were placed on various parts of the head, the boy could not localize the note in any particular ear, which peculiarity Dr. Dennert has noticed not unfrequently before in cases of positive unilateral and deep disease of the labyrinth. A low whisper the patient could not hear, not even when the cautions detailed below were observed. In order to find out what part the well ear had in hearing speech used as test, Dr. Dennert, together with Prof. Lucæ, tried the following method:

The well ear, which, when firmly stopped and turned toward the source of sound, could still hear, very correctly, a whisper repeated at a distance of six feet, was kept firmly stopped, while the affected ear was alternately stopped and unstopped. The result as to hearing was entirely unaltered



by the alternate opening and closing of the diseased ear. In cases of considerable one-sided deafness, when the perceptive power of the other ear remains good, the above-named observers always test the hearing for speech in the manner just described. "In order to prevent errors arising from the sense of feeling, a thin piece of paper may be held before the ear examined. If it is found that the ear tested hears better, both quantitatively and qualitatively, when opened than when it is closed, the hearing must be ascribed to it; but if the result remains the same with the ear opened and closed, then whatever hearing is found must be ascribed to the other ear.

"This method of testing the hearing is not only important in detecting one-sided deafness, but also for determining the degree of one-sided hardness of hearing, because without these cautions the latter might be considered entirely too slight."

Prof. Lucæ contributes a paper on the same subject, with special reference to the present methods of testing the hearing. He narrates a case of loss of the cochlea, in which there was, apparently, hearing in the diseased ear, but which he shows to have been due to the hearing power of the good ear.

The method employed in testing this case was that already described in the reviews of Dr. Dennert's paper. Prof. Lucæ says: "This case shows that, even when the good ear is closed, a low whisper could not be used as an isolated test for the deaf ear. Patients with normal hearing can hear whispers near their ears when both ears are stopped. This might be considered due to imperfect stoppage of the auditory canal." This may be the case sometimes, but that a low whisper may be heard, even when the auditory canal is absolutely hermetically closed, is shown by the history of a case of congenital deficiency of the auricle and external auditory canal, which was observed by Prof. Lucæ in 1869.

"Siegfried M., twenty-three years old, has always, until the present time, enjoyed good hearing. The latter has become impaired, within a few weeks, on account of a severe cold in the head. His speech is perfect. *On both sides there is complete cartilaginous closure of the auditory canals.* Words spoken with moderate loudness are heard three feet on the right, and four feet on the left side. A whisper is not heard

at all on the right side, but, on the left side, whispered numbers, as, for example, 606, are distinctly heard, when repeated near the auricle. There is chronic naso-pharyngeal catarrh. Auscultation on the mastoid process reveals loud, moist *rdles* during inflation of the tympanum with the Eustachian catheter. After the air-douche a low whisper is heard on the right side, near the ear, and on the left side more than one foot and a half."

It is, therefore, says Prof. Lucaë, highly important, if we wish to avoid the grossest errors, that always, in every case of unilateral functional disturbance, the ear to be examined should be alternately closed and opened during the testing with speech. By observing these precautionary measures in the future, a large number of useless remedies and wonderful cases of one-sided deafness will disappear from our literature, as the latter have been really nothing more than permanent improvement in the hearing of the slightly-affected better ear.

This valuable article closes with the remark "that the case of destruction of the cochlea alluded to is of importance in deciding the diagnostic worth of so-called bone-conduction, for it shows that, in unilateral necrosis of the cochlea, the tuning-fork, placed anywhere on the cranium, is by no means uniformly heard only in the well ear."

At the International Congress of Medical Sciences, held at Brussels, September, 1875, Dr. Delstanche, *père*, opened the discussion on "the methods of measuring the hearing and registering its degree in a uniform manner for all countries." The following conclusions were given :

1. In the normal state, the ear perceives indifferently and equally well all the noises which fall upon it, no matter what their nature may be; so that a simple acoumetre (a single sound) might be adopted as a common measure of hearing for all countries.

But, in a pathological condition, the hearing varies according to the individual; deafness is sometimes partial, and is confined to noises and isolated sounds, as though some notes were wanting in the acoustic piano; at other times it becomes generalized, and extends to all noises and sounds indistinctly. In these conditions it is evident that an acoumetre of a single



sound would not suffice; the examination would not be complete without the aid of different acoumetres, or of an apparatus combining different acoumetric elements, as, for example, noises and sounds of different pitch and intensity, which could be isolated or combined according to the wish of the surgeon.

An apparatus was described which combined in a measure these qualities. But M. Delstanche was of the opinion that, until the human voice can be imitated, the examination by the voice must be the indispensable complement of artificial acoumetry.

2. The metre should be the unit of measure of the distance. If the acoumetre should not be heard at a distance, the methodic use of a tuning-fork would give an appreciation, more or less exact, of the degree of hearing.

3. Several ways of registering the hearing have been proposed, but for precision and conciseness none equal the short method now in usage for indicating the frequency of the pulse, of the respiration, and of the temperature of the body. The words watch, quality, voice, right, and left, should be represented by their initials; the distance a watch may be heard by a normal ear, as well as the distance it is heard by the affected ear, should be represented in metres and centimetres.

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## PART II.

### *Pathology and Therapeutics.*<sup>1</sup>

By CLARENCE J. BLAKE, M. D., Boston.

One hundred and four out of the two hundred and fifty-eight pages of the work of Prof. Bernstein are devoted to sound and hearing. The work, as a whole, is more thorough, and at the same time better suited to the comprehension of the general reader, than are most of the rapidly multiplying books of this class. It is also clearly printed and well illustrated.

<sup>1</sup> In consequence of the illness of Dr. Bertolet, that part of the Report on Otology which relates to Pathology and Therapeutics has been written by Dr. Clarence J. Blake.

As a popular rather than a purely scientific work it would be out of place to present an intimate review of the several chapters devoted to the sense of hearing. The author's views in regard to the physiological value of different portions of the auditory apparatus, and comparison with the views of other writers, are clearly stated in language appropriate to a work of this kind, and enough is given of the minute anatomy of the ear to make the functional importance of the various structures clear to the reader.

*Hearing.*—Under this heading Exner devotes considerable space to a discussion of the differential stimuli in approximate tones. Vibrations are intermissions which are made known to us by a group of sensory elements. Helmholtz says that the vibrations of  $h'''$  and  $c'''$  can still be heard—there are 132 per sec.—the smallest difference would, therefore, be 0.0075 sec. In so far, however, as in this case, sixteen partly very weak vibrations of the tympanum occur between two pauses, Exner imagines that the time during complete pauses might be still smaller. A Savart's wheel, with only three adjacent teeth, which struck a piece of sheet-iron, was turned with a velocity which increased until the double stroke became converted into a single one. The smallest difference for two stimuli was reckoned from the rapidity as .002 sec. The crackling of two electrical sparks was heard separately when more than .002 sec. separated them. The smallest difference for different elements of the same ear is less than .01 sec., because Helmholtz's quaver sounded quite well when eight to ten shocks per sec. were given. Exner supposes that here also a smaller difference, varying essentially, would be found if the two tones were only once sounded. The smallest difference between the two ears is 0.064 sec. Two elastic balloons were struck, one after the other, by means of an elastic spring; these balloons were provided with tubes, which, by means of an adaptor, accurately fitted the auditory meatus; both springs were discharged by means of a pendulum; when a sensory impression affected the eye and ear simultaneously, the auditory impression was sooner felt than the visual one. The smallest difference in Exner's case was 0.16 sec.

Incited by the interesting and successful experiments

of Prof. Coccius on the examination of the eye in polarized light, Drs. Hagen and Stimmel have applied the same method of examination to the ear. The apparatus employed for the purpose consisted of a plain mirror of 13''' Par. diameter, having a central opening of 3''' Par. diameter, placed between two Nicol's prisms, each of which, surrounded by cork, was contained in a brass case. The mirror was surrounded by a metal ring having joints at two opposite points, one of which united the mirror with the metal case of the large Nicol prism, and allowed the mirror to be placed at various angles to the large prism. The opposite joint united the mirror to the smaller metal case of the second prism which was placed behind it. The case was set obliquely from left to right in such a position that the smaller prism, with each change in position of the mirror, could be placed vertically to the central opening of the latter. The smaller prism, furthermore, was movable in its metal case, so that, during examination, its plane of polarization could be placed at right angles to the plane of polarization of the larger prism. The authors also found it of advantage to add a ball-and-socket joint at the lower portion of the ring holding the mirror for attachment of a twelve-inch convex lens. By placing this lens over the face of the mirror, the latter was converted into a concave mirror of six inches focus, and, by placing the lens behind the mirror, it served to enlarge the picture, while, in order to examine with the mirror alone, it was only necessary to turn the lens downward. The strong illumination necessary for this method of examination was furnished by a Tobold lamp. The lamp was placed at the left of the observer at the height of the ear under examination, and in such position that the column of light passed close to the ear at right angles to the long axis of the meatus. An ordinary speculum was placed in the ear and held by an assistant. With the left hand, the larger prism was placed at a distance of about half an inch from the opening of the Tobold lamp, while the right hand seized the smaller prism placed behind the mirror, and set the latter at an angle of about  $45^{\circ}$  to the larger prism. The instrument was held nearly horizontal, so that the light from the lamp, passing through the larger prism

or polarizer, fell upon the mirror and was reflected into the ear. On examination, under these circumstances, the ear presented the usual appearance, but, on placing the smaller prism or analyzer behind the mirror, and bringing its plane into position by turning the metal case, the effect of polarization was produced, the light returning from the membrana tympani through the opening in the mirror, passing through the analyzer before reaching the eye.

Under these circumstances the following changes in the appearance of the membrana tympani are observed: The delicate lustre which overspreads the normal membrana tympani is wanting; the light reflex disappears; the location of the light reflex, however, is of a bluish-white color, and somewhat lighter than the adjacent parts; the explanation of this is probably that the light-rays returning from this portion of the membrana tympani are largely absorbed by the polarizing mirror; other light spots upon the surface of the membrana tympani, and the reflections from fluids in the meatus or on the membrana tympani, also disappear.

Transparent portions of the membrana tympani, moreover, may apparently be made entirely to disappear. A very common condition was the entire disappearance of the posterior superior segment, rendering the long process of the incus and portions of the stapes and promontorium visible. Other portions of the membrana tympani presented the appearance of a delicate veil. It was also possible to determine the presence of adhesions and pseudo-ligaments in the tympanic cavity. All opacities of the membrana tympani, such as calcareous deposits, ecchymoses, and the like, appear more distinctly defined, and the blood-vessels of the manubrial plexus were more clearly visible.

Enough has been done, as shown by the above short review of the results arrived at by the observers, to demonstrate the advisability of further experiment upon the use of polarized light in examination of the ear; and the suggestions thrown out in their paper as to examination of the movements of the ossicula and of morbid appearances, such as serous or purulent accumulations within the middle ear and the various forms of opacity of the membrana tympani, point



to a larger application of this means of illumination than that of a simple experimental test.

In the otological section of the Naturforscher-Versammlung in Gratz, Kessel, after reviewing the various means employed for determining the degree of hearing-power, describes a new instrument which he has constructed for this purpose. This consists of a series of metal tongues set in vibration by means of pins arranged upon a metal barrel, after the fashion of a music-box. The tongues give the tones of the C scale for six octaves, the compass of the instrument may be easily increased to eight octaves; aside from the musical tones, noises may be reproduced by setting several of the tongues in different octaves in vibration at the same time. The barrel is turned by a handle, on which is an index traveling over a dial-plate and indicating the pitch of the tone produced. The atmospheric conduction of the sound is insured by means of a rubber tube passing into the interior of the apparatus, surrounded by non-conductors and inclosed within a box, so that, except through the tube, no sound can be heard even at a slight distance. The bone conduction is determined by means of a metal rod, one end of which is attached to the tongue-plate, the other being brought in contact with the mastoid process. As with this arrangement, in addition, the air in the external ear can be alternately rarefied and condensed, and the tension of the membrana tympani and the intra-labyrinthine correspondingly varied, it is possible to determine under what conditions the test-sound is best heard.

The apparatus further shows that, when the same tone is heard in differing degrees of intensity in the two ears, it is heard apparently only in the ear subjected to the louder tone; as, for instance, if the right ear is brought so near the instrument as to perceive the tone plainly, and the conducting tube is then placed in the left ear, the tone is heard apparently in the left ear only. Dr. Kessel spoke also of the possible bearing which this experiment might have in explaining the determination of the direction of sound.

The requirements which should be met by an instrument for testing the hearing, and which it has been the author's



endeavor to compass in the instrument described, he classifies as follows :

1. The instrument should include in regular scale as large a number of tones as possible, at least those comprised within the limits of the scale of the human voice.

2. The intensity of the tones must be uniform.

3. It must be so constructed as to permit application of the test to one ear alone, both as regards atmospheric and bone conduction.

4. The intensity of the tones should approximate that of vocal sounds in speech.

Dr. Knapp proposes a new use of the tuning-fork in cases of one-sided deafness, which, with the explanation of its advantages, may be best given in the author's own words: "If a vibrating tuning-fork is moved up and down, before a healthy ear, its sound appears enforced as often as the instrument passes the level of the external auditory canal. If we, however, tightly close the ear before which the fork is moved, the sound appears no longer periodically louder, but uniform, being perceived mainly by the other ear. If the closure of the one ear is not complete, the periodic enforcement is still perceptible, though less marked. If a vibrating tuning-fork is moved up and down before a totally deaf ear, the sound of the tuning-fork invariably appears uniform."

The waves of sound in this case travel in circuitous roads around the head to the membrana tympani of the healthy ear, never impinging on it in a direct way, which in the previous experiment produced the periodic enforcement of sound. Another method of detecting one-sided deafness, proposed by the author, consists in the use of the pneumatic otoscope of Siegle. When this instrument is applied to the healthy ear, the movements of the membrana tympani are distinctly heard as a sound at a low pitch. Patients hearing well with one ear, but being deaf in the other, hear the difference readily, the healthy ear receiving a marked sensation of sound, the deaf ear no sensation of sound at all.

A new method for inflation of the middle ear, recommended by Gruber, consists in a modification, or rather combination, of the use of the ordinary air-douche and the Val-

salvan experiment; the object being, where it is desirable, to dispense with the use of the catheter to close the upper portion of the pharyngeal cavity from below, and produce a pressure in the naso-pharyngeal space which shall extend to the middle ear. This may be accomplished by substituting for the act of swallowing the intonation of certain syllables or consonants, which is accompanied by forcible elevation of the posterior portion of the tongue pressing the soft palate upward and backward against the posterior pharyngeal wall.

This movement is most pronounced on sounding the consonant *k* without the accompanying vowel-sound. Simultaneously with the sounding of *k*, or, better still, *hk* by the patient, air is forced into the nostril by means of the balloon in the usual manner. By interposition of a vowel-sound between the *h* and *k*, closure of the naso-pharyngeal space is more effectual, and by interposing *a*, *e*, *i*, *o*, and *u*, in succession, as, for instance, *hack*, *heck*, *hick*, *hock*, *huck*, the backward pressure of the tongue is effected in a regularly-increasing ratio. By the use of these syllables a measure of the degree of pressure is therefore obtained, and, by inclination of the patient's head to one side or the other, the air is forced into the ear which is uppermost.

Kutscharianz presents the results of the examinations of cases of inflammation of the middle ear in three hundred infants of various ages. After considering the normal condition of the middle ear in the fœtus and new-born infant, the author proceeds to an examination of the changes which occur in different portions of the middle ear in case of inflammation. At the fourth month of intra-uterine life, the middle ear consists simply of a cavity containing three folds, perfectly transparent and rich in blood-vessels, the largest of which is described by Von Tröltzsch, surrounding a very small, irregular cavity in which is a clear aqueous and slightly tenacious fluid. The histological structure is not the same in all of these folds, the larger possessing cylinder and the two other pavement epithelium.

At the fifth month there is but little change, the folds are diminished, and the space is somewhat larger. At the end of the sixth month (two cases), and at the end of the seventh

month (three cases), the two smaller folds had almost entirely disappeared, while the larger remained almost unchanged. The space containing fluid had increased. At the eighth month (two cases), the lining of the cavity was of nearly uniform thickness, and the space containing fluid was quite as large as at birth. In three still-born infants, and in one dying shortly after birth, the tympanum was found completely formed and filled with a transparent fluid; the lining mucous membrane was brilliant, adherent to the subjacent bone, of a reddish or roseate color, and consisting of three coats, in all about 0.08 mm. in thickness. In twenty infants from one day to seven and a half months of age, the tympanic mucous membrane presented much the same appearance; in the majority of cases the cavity contained only air, with sometimes a little transparent mucus or cellular *débris*.

From these observations he divides all the cases which vary from the normal type into two classes :

1. Those in which with an intact, or nearly intact, mucous membrane the contained fluid is abnormal.

2. Those in which both the mucous membrane and contents of the tympanic cavity are abnormal, which is more frequently the case.

*A* includes thirty cases of children, from three days to seven months old. The mucous membrane was intact, but the fluid contents of the cavity were abnormally increased in quantity, of the consistence of the white of egg, and showing under the microscope a considerable quantity of degenerated cylindrical epithelium-cells and detritus. The tympanic mucous membrane was intact but hyperæmic, membrana tympani and Eustachian tube intact, the latter free. Pharyngeal mucous membrane reddened and swollen. In the majority of the cases there were bronchitis, broncho-pneumonia, gastro-enteritis, or disease of the brain and meninges.

*B* includes more than two hundred cases of new-born and nursing infants, dying from various diseases. According to the character of the inflammatory process, these may be divided into three groups :

1. Slight catarrhal inflammation, with slight separation of the epithelium.

2. Intense catarrhal inflammation, considerable swelling of the mucous membrane, and general separation of the epithelium.

3. Purulent inflammation, with ulceration of the mucous membrane.

The author concludes that the differences signalizing these three groups represent simply progressive stages of the same disease, and that a certain part in these inflammatory processes, aside from communication of inflammation from neighboring structures, may be accorded to the entrance of air into the tympanic cavity during respiration.

In a paper published in the *Monatsschrift für Ohrenheilkunde*, in 1868, and in subsequent papers, some of which have appeared quite recently, Wreden has directed the attention of medical jurists to the entrance of air into the middle ear, and the disappearance of the gelatinous substance which fills the tympanic cavity prior and up to the birth of the child. These communications, in which the author claims for this test an equality to, if not an advantage over, the ordinary test by examination of the lungs, have called forth considerable testimony in rebuttal, and among the papers published, both in Germany and England, is an interesting table given by Ogston. Wreden states that the gelatinous substance mentioned disappears within twenty-four hours after birth; that twelve hours' respiration is not sufficient to effect its complete disappearance; and he therefore suggests that the presence of air in this situation might be of importance in a medico-legal point of view, as proving that respiration had taken place.

Ogston, on the other hand, considers that these statements have been made without sufficient grounds, and that they require considerable modification. In support of this opinion he submits the following table of fifteen cases:



	AGE.	State of Middle Ears.	State of Lungs.	Cause of Death.	Other Facts to fix the Term of Life.
1	14 w'ks.	Filled with air.	Fully expanded.	Smothering.	Bronchitis.
2	9 "	"	"	"	"
3	2 mon's.	Filled with fluid.	"	"	"
4	6 weeks.	R. air, L. Muddy fluid.	"	"	Bronchitis.
5	1 month.	Filled with air.	"	"	"
6	4 weeks.	R. air, L. air and fluid.	"	Broncho-pneumonia.	"
7	8 days.	Filled with air.	"	Bronchitis.	Lung bulky, emphysematous.
8	3 "	Containing air.	"	Smothering.	"
9	2 hours.	Fluid and yellow substance.	Partly expanded.	Apoplexia neonatorum.	Breathed feebly two hours.
10	New born.	Containing fluid.	Expanded.	Smothering.	Meconium in large intestine.
11	"	Filled with red fluid.	"	Fracture skull.	"
12	"	Containing fluid.	"	Smothering.	Navel-string attached.
13	"	Containing red fluid.	Partly expanded.	Query.	"
14	"	Containing air.	Expanded.	Smothering.	"
15	"	Containing fluid.	Unexpanded.	Still-born.	"

The first six cases might have been omitted from the table in this connection. The last nine, says Prof. Ogston, are those in which Wreden's proposed test would be supposed to be useful, but in only three (7, 8, and 14) was air found in the middle ears, although the lungs in all, with exception of a still-born, immature infant, contained sufficient air to float in water, and from all air could be expressed when held under water.

It may be very justly said that Dr. Böter's paper, among the numerous otological dissertations which have proceeded from the medical school of Halle, is especially worthy of notice. The author gives a very comprehensive review of the literature of the subject, and draws his conclusions from these and from his own observations with commendable clearness.

The introduction, which directs attention to the fact that, in consequence of anatomical structure, necrosis can occur only, with the exception of the external auditory canal, in the osseous labyrinth, enumerates chronologically, with commentary notes, the cases of necrosis of the labyrinth, accompanied by descriptions of the osseous preparations, which



have been recorded since the first paper of Welde in 1855. In all the sixteen cases given, with the exception of that reported by Dr. Cassell (of Glasgow), there was absolute deafness, and in seven of these also facial paralysis.

This table is followed by a discussion concerning the relatively rare occurrence of necrosis as compared with caries, and of the influence which age, sex, and general constitutional condition, may have in this connection.

As immediate cause of the pathological process in the osseous structures of the labyrinth, there existed in all the cases, with the exception of that of Wilde, a purulent inflammation of the middle ear, with periostitis of the petrous portion of the temporal bone of several years' duration. In support of the occurrence of the necrosis of the labyrinth as a more or less isolated affection, the author cites the notes of Von Tröltsch in this connection, namely: the early and complete ossification of the labyrinth, its nourishment by especial non-anastomosing vessels, and, finally, its extraordinary solidity of structure. The frequent coincidence of facial paralysis with necrosis of the labyrinth occurring in seven of the sixteen cases, the author refers to the topographical relations of the outer and superior semicircular canals and cochlea to the Fallopian canal, which would render a necrotic separation of any of these structures, without injury to the canal and facial nerve, out of the question—an opinion which is fully supported by the pathological observations in the cases given.

As an explanation of the existence of a necrosis of the labyrinth without implication of the surrounding spongy bone, the author presents two possibilities, namely: embolism of the internal auditory artery, which probably existed in the case of Wilde, where the necrosis was not preceded by a purulent inflammation of the middle ear; and purulent periostitis of the labyrinth as a result of chronic purulent inflammation of the middle ear, the means of communication being afforded by destruction of the *membrana tympani secundaria*; numerous *post mortems* in such cases showing the course of the disease, which terminated fatally before complete necrosis of the labyrinth occurred. A further proof of the correctness of this assumption is found in the presence of polypi accompanying

the chronic purulent inflammation of the middle ear in the majority of the cases, with the consequent retention of the foul secretions and increased pressure. In this connection the author directs attention to the comparative immunity from the pathological process possessed by the semicircular canals, and finds in the comparatively frequent implication of the cochlea alone an evidence of the correctness of the assumption that the fenestra rotunda serves as the channel for the communication of the purulent periostitis to the labyrinth; for, did this occur by means of a fistulous opening into the semicircular canals or through the fenestra ovalis, observations would not be wanting of separation of the semicircular canals alone. As symptoms of the rupture of the membrana tympani secundaria and the extension of the purulent periostitis, the most characteristic are the sudden occurrence of loud subjective noises, deep-seated pain, vertigo, nausea, and vomiting. Following the enumeration of symptoms, the author gives notes as to the duration of the disease in the several cases mentioned, from the first implication of the labyrinth to the time of its separation—in some cases until removal of the necrosed cochlea. The thesis concludes with a review of the prognosis and treatment of this comparatively rare complication of middle-ear disease.

In connection with the above thesis a case recently reported by Prof. Lucaë is of especial interest. The patient, a strong, healthy man, dated his affection of the right ear from the year 1866, when during artillery-practice following the discharge of a field-piece he noticed a sharp pain in the ear, followed by slight hæmorrhage; with exception of deafness he had no further symptoms of trouble for several years, until, in October, 1874, there appeared a purulent sanguineous discharge from the ear, accompanied by a chronic headache confined to the right side of the head, and frequent vertigo, which finally led him to seek relief at the hands of the author in May, 1875. At this time the whole of the right auricular region, both in front of the tragus and over the mastoid process, was slightly tender on pressure and percussion; no swelling, however, was visible. The external auditory canal was swollen and filled with offensive pus, removal of which

revealed deep-seated granulations. The left ear being tightly stopped, words whispered close to the right ear were distinctly heard. Ordered syringing with salicylic acid (1 : 600). Four days later swelling continued; wet compresses applied for seven days, with relief from pain, tenderness, and swelling. At this time pressure upon the mastoid gave little or no pain, and an examination after thorough syringing revealed in the cartilaginous portion of the auditory canal a hard body, about the size of a pea, of a dirty-grayish color. This was removed with the forceps, and proved to be the upper two-thirds of the necrosed cochlea. Tests for hearing now gave the following results: With the left ear tightly stopped, whispered words were heard as before; but on also closing the right ear, the whisper was heard with equal distinctness. Tests with König's rods gave the same result. The tests for bone conduction were especially noteworthy. The large tuning-forks C' C and contra A applied to the forehead were heard only in the unaffected ear; applied to the vertex, however, apparently equally well in both ears. The large C fork being applied to the right mastoid, the patient was uncertain as to whether the sound was heard only on the right or also on the left. The butt of the fork being applied to the right meatus, the vibration was felt only.

Nine days later, the meatus was but slightly swollen, granulations and discharge had nearly disappeared, the opening in the anterior portion of the membrana tympani was plainly visible, the headache and vertigo had entirely disappeared, and the patient passed from observation. Four months later his condition remained the same, and there had been no recurrence of the otorrhœa. This case is interesting from the original cause of the trouble and the later occurrence of more serious disease, the comparative immunity of the patient from the graver symptoms which might have been expected, and the progress of the ultimate necrosis to a favorable result. It demands further consideration also from the results of the tests with regard to the hearing, upon which Prof. Lucæ lays particular stress. The apparent perceptive power remaining to the affected ear is in itself a sufficient commentary upon the necessity for careful tests in compara-

tive cases; the degree of sound, conductibility, not only of the ear itself, under pathological conditions, but also of the circumjacent parts, being an open question.

Voltolini directs attention to a form of mastoid periostitis as yet undescribed by otological authorities.

Slight mention of independent mastoid periostitis is made by Wilde, and also by Gruber,<sup>1</sup> and it has been the fortune of the reviewer to have observed one case in which the acute periostitis of the outer surface of the mastoid was hardly referable to any extensive inflammatory process of the middle ear.

The etiology of the ordinary mastoid periostitis has been so carefully studied and so richly illustrated during the past few years, that the first question which occurs to the reader of this paper concerns the possible origin of an inflammation of so severe a character, independent of any previous inflammation of either the outer or middle ear. Voltolini considers the disease described as much peculiar to the mastoid region as is the othæmatoma peculiar to the auricle, and, as regards its etiology, remarks that he has observed such cases in Silesia only, although, as is well known, he has had control of ample otological material previously in the far north, and in Pomerania and Berlin. The disease appears to result from exposure to cold, at least this was the explanation given by several patients. The region implicated also is that portion of the post-auricular surface free from hair and particularly exposed, and what is further characteristic, not only one side, but the corresponding region behind both ears, was sometimes similarly affected.

The ear itself remains intact, but may sometimes in the course of the disease participate in the inflammation.

The disease begins with severe tearing pains on one or both sides of the head, which extend to the side of the face and teeth; later, fever sets in, and the pain becomes localized about the posterior auricular region; the mastoid surface becomes swollen, smooth, red, tense, and tender. If active anti-phlogistic treatment does not relieve these symptoms, the case progresses to suppuration, under which circumstance the best

<sup>1</sup> *Oester. Zeitschr. für prakt. Heilkunde*, 1863.



remedy is, as always, the knife. The same rule with regard to the early use of the knife holds good in these cases as in those where the superficial periostitis follows an acute inflammation of the middle ear.

The following cases are cited in illustration: A shepherd, forty years of age, was attacked, after exposure, with severe pain, swelling, redness, and tenderness above and behind the right ear; the application of eight leeches did not diminish these symptoms, and, on the following day, a long, deep incision was made over the mastoid. The pain was almost immediately relieved, the patient slept well, and made a good and speedy recovery.

A woman, forty years of age, after exposure in the open air with the head uncovered, had severe pain in the left side of the head, which finally became confined to the region of the mastoid; the hearing being somewhat diminished, the patient was first treated by the family physician for a supposed ear-disease.

The author being called in consultation, found the region behind the ear red, swollen, and tender; with exception of a slight swelling of its posterior superior wall, the external auditory canal was normal; the membrana tympani presented no specially abnormal appearance, nor were there signs of deeper-seated trouble. Three days later, after application of poultices in the interim, an incision was made over the mastoid with liberation of a considerable quantity of foul pus and relief from pain, this case also proceeded to a favorable recovery. The third case did not end so fortunately, on account of the refusal of the patient to submit to the incision as proposed by the physician in charge. The symptoms were the same as in the two preceding cases, but the want of an early and free exit for the pus, which finally made an opening for itself, resulted in extensive burrowing of the pus, and finally death, following erysipelatous inflammation.

In this case the patient, a gardener, fifty-six years of age, had driven in an open cart in the winter of 1874 for a mile across the open country with a cold wind and snow blowing upon the back of his head; on the following day severe pain in the head set in, which finally became located behind both ears, to be followed by the symptoms and result stated.



The thesis of Dr. Hartert is devoted to consideration of the subject of exhausting pus or other fluids accumulated in the middle ear—the motive to the investigation being furnished by the article of Prof. Gruber on this subject, in the *Monatsschrift für Ohrenheilkunde* of December, 1874. The following experiments were made:

1. The soft parts having been removed from the head of a recent subject, and the membrana tympani exposed, an opening was made in the tegmen. tympani and the middle ear filled with a carmine solution. A perforation was then made in the posterior segment of the membrana tympani, and the fluid sucked out by means of Gruber's syringe. On further removal of the tegmen. tympani, it was found that the fluid had been wholly exhausted, without injury to the membrana tympani or adjacent parts.

2. The experiment was repeated through an opening in the anterior segment of the membrana tympani, the fluid being wholly removed, even from the depressions in the floor of the posterior portion of the tympanum, without injury. In no case was it possible, however, to push the point of the instrument through the membrana tympani as far as the antrum mastoideum without dislocating the incus. Under the latter circumstance, however, fluid could be sucked from the mastoid cells. When the head was placed in proper position, the carmine solution injected into the mastoid cells from without flowed into the middle ear, and was easily removed. The advantages of this method are considered by the author to be:

1. That patency of the Eustachian tube is rendered unimportant.

2. That the secretion accumulating on the floor of the tympanum, and not affected by the use of the air-douche, is easily and entirely removed.

3. That the danger of forcing secretion into the mastoid cavity is avoided.

Dr. Paulsen presents his experience in the use of carbolic acid in the treatment of purulent inflammation of the middle ear, and, claiming nothing new, gives his observations on the results of its application in the manner which he describes.

The ear to be treated is first carefully cleansed, and dried

with charpie or cotton—cleansing by syringing, unless absolutely necessary, being objectionable, in view of the further treatment, which consists in touching the affected parts thoroughly with cotton tampons dipped in a mixture of carbolic acid and olive-oil, ten parts of the former in one hundred parts of the latter. After the touching, a cotton tampon slightly moistened with the above mixture is introduced and allowed to remain until the following day.

Obstinate and neglected cases of otorrhœa, or those which have resisted other measures, have improved in a few days under his observation and with this application. Cases of otorrhœa accompanied by caries should, of course, be excluded from the list of favorable cases.

Small polypi and remnants of polypi, especially such as are found in the tympanic cavity, where a comparatively small perforation of the membrana tympani makes them difficult of access, are easily and satisfactorily treated in this manner; indeed, the author gives this application the preference over the use of ordinary astringents, and has obtained excellent results after the removal of polypi, where there is a tendency to their renewal. The mixture of carbolic acid and olive-oil in various strengths is also found preferable to its use diluted with water, or the use of the carbolized cotton.

The case reported by Darolles is a sufficient commentary upon itself, and may be quoted as presenting the course of the disease without surgical interference.

A woman, thirty-eight years of age, having caught a severe cold after a rheumatic attack, had severe pain and almost total deafness in the right ear. Three days later there was rupture of the membrana tympani, and with the appearance of a purulent discharge the pain diminished; the deafness, however, continued. Two days later a recurrence of cephalalgia, the discharge diminished and there was tenderness on pressure over the mastoid. On the tenth day complete facial paralysis on the right side, and from this time forward marked fever and obstinate constipation. On the thirteenth day, contraction of the muscles of the neck, pulse 130, temperature 40.8°. On the fifteenth day, opisthotonos, herpetic eruption of the face, on the right side about the lips and angle of the

eye, and on the left side about the centre of the cheek. On the sixteenth day, profuse perspiration, involuntary evacuations, paralysis of the left arm; pupils dilated and reacting slowly, thready pulse, and temperature of  $40.8^{\circ}$ . In the evening the patient died. The section showed injection of the veins of the pia and dura mater, extensive purulent infiltration of the subarachnoid cellular tissue, especially at the base, and also on the convexity of the right hemisphere. Small insulated collections of pus were also apparent along the course of the blood-vessels on the convexity of the brain; in several places the pia mater was adherent to the gray substance. The outer surface of the petrous bone was intact, the tympanic cavity filled with pus, in which the ossicles floated free; there was a small perforation in the upper portion of the membrana tympani. The mastoid cells were also filled with pus, and the facial nerve, laid bare at the point at which, in the hiatus Fallopii, it makes its second turn, was covered with thick pus; the remaining walls of the tympanic cavity were intact.

The following case, reported by Tournevet, may be added to that above quoted:

A female teacher, forty-three years of age, never robust, and having scrofulous scars in the neck, was attacked, after taking cold, with severe intermittent pains in the right side of the head. These symptoms were followed by perforation of the membrana tympani, purulent otorrhœa, and later by cessation of the discharge, marked chills, and constipation. Three weeks later the cephalalgia diminished coincidently with the occurrence of pain in the left hypochondrium and decided fever; the pupils became dilated, the conjunctiva assumed a yellowish tinge, the tongue became heavily coated, the pulse dicrotic, the temperature rose to  $40.2^{\circ}$ , and delirium set in. The abdomen became tender, there were marked icterous and involuntary evacuations, the pulse could be barely felt, the temperature fell suddenly to  $36^{\circ}$ , and the patient died four weeks from the beginning of the attack. The section showed hyperæmia of the dura mater, especially on the right side, pseudo-membranous deposits on the arachnoid, the substance of the brain and ventricles intact. The outer surface of the temporal bone showed no signs of caries, but no

thorough examination was made. The spleen was swollen, and softened with *metastatic abscesses*; the kidneys hyperæmic, and in the right kidney two *metastatic abscesses*. There were also fresh peritonitis and numerous sub-mucous ecchymoses in the intestine.

Dr. Vajda reports an interesting case of syphilitic infection, which, his conclusions being correct, carries its own moral:

A servant-girl, twenty-seven years of age, appeared at the clinic with extensive papules of the mucous membrane of the mouth, and especially of the soft palate, tonsils, and posterior pharyngeal wall. On careful examination with the rhinoscope, the mouth of the left Eustachian tube was seen closed and surrounded by firm infiltration, the surface being opaque, white, and irregular. The cervical lymphatic glands were extensively inflamed. The patient was very deaf, and considered her present trouble due to the repeated use of the catheter, six months previously, for relief from a former deafness. The hymen was intact, and there was no sign of a specific lesion. Ten days later, inunction with oleate of mercury was begun. After thirteen applications, and touching the mouth with nitrate of silver, the local symptoms diminished. The condition of the throat and mouth improved and the hearing increased. The further treatment consisted in simple cleansing of the throat and mouth, and nineteen days later the patient was discharged.

Prof. Moos publishes the result of six sections in cases of patients suffering from aural symptoms who died of ileo-typhus. In all cases there were changes, the result of purulent inflammation of the middle ear, and in addition in the labyrinth an infiltration with lymphoid cells; in each case the utricle sacculæ ampullæ and lamina spiralis membranacea were affected; exceptionally, the semicircular canals, and the zona ossea. The reviewer of this paper, in the *Monatsschrift für Ohrenheilkunde*, doubts whether the above-mentioned change may be considered specific of this disease, as similar appearances have been discovered after severe otitis media unaccompanying typhus, the same appearance having also been found on examination after death from scarlet fever. The reviewer agrees with Gruber in his opinion that the labyrinth partici-



pates in the majority of severe inflammatory processes in the middle ear.

Prof. Moos reports the case of a boy, eight years of age, who had suffered at intervals for two years from pain in both ears and occasional otorrhœa, the hearing having previously somewhat diminished. At intervals of from four to eight weeks the patient had pain in the right ear, and every three or four weeks attacks of insensibility, lasting two or three hours, preceded by somnolency, occasional vertigo, intense headache, and palpitation; the hearing also was much diminished. During the attacks there was neither loss of equilibrium nor convulsions, the patient remained simply senseless and speechless. The increased deafness which preceded the attacks was so decided and so constant a symptom that the family were able to foretell and prepare for the attack of insensibility. At the termination of the attack vomiting occurred, followed by a return to consciousness. A fourteen-year-old brother of the patient had normal hearing, but was feeble-minded; and a brother of the mother had epileptic attacks, and died at the age of twenty-eight.

The objective examination of the patient showed a decided catarrhal inflammation of the nose and naso-pharyngeal space. Under local treatment, including paracentesis of the membrana tympani twice performed, the aural trouble improved, and after termination of the local treatment, the epileptiform symptoms disappeared and did not return during the nine months following, during which time the patient remained under observation. The author considers the inflammatory process in the middle ear as the origin of the trouble, this causing an irritation which, transmitted to the brain, gave rise to the symptoms, the character of which was favored by the hereditary disposition.

Dr. Hotz reports two interesting cases: the first, of a man forty years of age, having an otitis media purulenta of the left ear, of long standing. Following an exposure, he suffered from severe pain in and around the ear, and over the left side of the head. This pain was worse at night, and diminished, but did not cease, in the daytime. An examination showed puriform discharge through a small perforation in the mem-



brana tympani, which the writer enlarged to allow of better escape of the pus. There was neither tenderness nor swelling over the mastoid, but some tenderness below the ear; warm instillations and leeches relieved the pain. Twenty days later, however, the pain returned with great severity, accompanied by delirium; on the following day he became comatose at intervals, with stertorous breathing; the tongue was dry, pupils permanently contracted, and the discharge from the ear had apparently ceased. During the day there were rapidly-recurring remissions and exacerbations of fever. Forty-eight hours later there was paralysis of the left motor oculi, the pupil of the right eye was enlarged, and contracted but slightly under stimulus of light, and the patient died on the afternoon of that day. The autopsy showed a long, fresh coagulum in the longitudinal sinus, the other sinuses containing a large quantity of liquid blood. The subarachnoid space contained a large amount of exudation, the pia mater was exceedingly hyperæmic and infiltrated, and the lateral ventricles filled with a grayish-red flocculent serum. The periosteum of the petrous portion of the left temporal bone was smooth and well adherent, except in the immediate vicinity of the meatus auditorius internus; here the bone was denuded, and surrounded by a narrow zone of infiltrated periosteum; the meatus auditorius internus contained the auditory and facial nerves, imbedded in thick, creamy pus. A section of the petrous bone showed the internal and middle ears to be joined in one common cavity filled with pus; there was also pus in the mastoid cells. A probe could be easily passed from the meatus auditorius internus into the middle ear.

The second case was that of a man forty-five years of age, who had suffered for several years from a chronic catarrh of the naso-pharyngeal space. Following an acute ulcerative inflammation of the throat and a severe cold, the patient had an acute inflammation of the right middle ear, followed by perforation of the membrana tympani and muco-purulent discharge. At this time there was no pain in the ear or head, but tenderness on pressure over the mastoid foramen. After midnight of the day on which this examination was made, he awoke complaining of chill, and had a violent rigor, lasting

over half an hour, followed by high fever, accelerated respiration, and delirium, and, later, vomiting. On the following day the pulse was 120, and small; skin hot, clammy, and sallow, and expression apathetic; eyes widely open and staring, pupils fixed and dilated; constant delirium and stupor, and a discharge from the ear of a sanious fluid of a light chocolate color. The mastoid was neither swollen nor tender, but, below the ear, there was a diffuse, moderately hard tumefaction, following the course of the jugular vein; respiration became accelerated and imperfect, and the patient sank rapidly and died in the afternoon. An autopsy showed the left lateral sinus filled with dark liquid blood, and, in the right lateral sinus, running along the petrous portion of the temporal bone, a grayish-red thrombus, firmly adherent to the wall of the sinus, and traceable into the beginning of the jugular foramen. The jugular vein was filled by a dense, firm clot, presenting the brownish, granular appearance of a clot not recently formed. The mucous membrane of the tympanic cavity was intensely red, that cavity, and also the mastoid cells, being filled with puriform matter. There was general and intense congestion of the right cerebral lobe, and an embolic condition of the meningeal vessels.

Hagen reports the results of his use, for the past nine months, of subcutaneous injections of strychnine in cases of nervous deafness. He finds this treatment of unquestionable value and permanent effect. An aqueous solution of one per cent. is used every third day, and injected under the skin covering the mastoid process. In the cases in question, little or no other treatment was employed. The injections of strychnine seemed to have no effect whatever upon the subjective symptoms.

Charcot having observed in several cases that the attacks which occur during the progress of Ménière's disease were preceded by a loud, whistling, subjective noise, and that, like the *aura epileptica*, this was the premonitory symptom of the vertigo, loss of coördination of motion, nausea, and vomiting, which quickly followed, was led to attempt the substitution of a similar physiological symptom by means of quinine, thereby aborting the subsequent attack. For several cases

which, according to Revillot, presented the group of symptoms characteristic of the so-called Ménière's disease, Charcot gave from 0.75 to 1.20 gramme of sulphate of quinine daily, continuously for several weeks. The subjective noise resulting from the administration of the quinine was kept up for several weeks at a time, and the remedy was omitted, occasionally, only in case of disturbance of digestion, and then resumed.

In a majority of the cases a decided improvement was effected, and in some, so far as the attacks mentioned were concerned, a complete relief followed. Whether the marked symptom of the disease—the deafness—was also relieved, the paper does not state. In a later number of the same journal, Dr. Barcot gives the results of the administration of quinine in similar cases with equally good effects.

Luys gives the results of careful *post-mortem* examinations in two cases of deaf-mutism of long standing, and finds, in his microscopic sections, ground for the opinion which his paper sets forth, that the intra-cerebral point for the transformation of the sensation of sound lies in the posterior portions of the thalami optici, while the ultimate point of perception is to be found in the posterior region of the cortical substance. In both of the cases examined the posterior portion of the thalamus opticus was of a grayish color, softened, with serous infiltration resembling a colloid substance, and exhibiting a large number of amyloid bodies. The gray substance in the neighborhood of the aqueductus Sylvii was changed in the same manner. The continuations of the nervi acustici in the fourth ventricle were visible in the form of indistinct grayish oedematous fibrils.

The first part of Mr. Field's paper, as read before the Harveian Society, is devoted to a definition of the term *tinnitus aurium*, to quotations from various authors, ancient and modern, as to its causes and importance as a symptom, and to an enumeration of various remedies, empirical or otherwise, which have been suggested for its relief. "I think," the author says, "the mischief can always be traced to the *membrana tympani*. We rarely find *tinnitus* present in cases of perforation from ulceration, and incising the membrane no

doubt will afford relief if a permanent opening can be established." When remedies applied to the removal of the supposed cause of the tinnitus aurium have proved inefficient, the author has employed faradization, which he has rarely found to fail.

"In point of fact I have no hesitation in saying that faradization applied directly to the tympanic membrane will either materially relieve the patient from the noise he has been suffering from, or stop it altogether."

"With reference to electricity as a remedy for severe noises in the ear, I maintain that the good effect I have obtained is due to the stimulation of the intrinsic muscles of the ear, just as in other parts of the body paralysis is often overcome by the same means."

Seventeen cases are mentioned in which tinnitus aurium, more or less severe, disappeared after faradization for a longer or shorter period. There is no detailed statement of other symptoms, and only a superficial description of the objective symptoms in any case. The author's investigations have been limited to the boundary of the lines in Hinton's appendix to Toynbee's work: "It seems better that the causes of tinnitus should be held as yet a very open question." His views as above given are submitted to the judgment of the reader.

Dr. Theobald's paper is a most interesting and comprehensive "attempt to explain the production of tinnitus aurium in accordance with physical principles." Primarily this author is of the opinion that as the optic nerve, individually, with exception of the retina, is not sensitive to light, so the auditory nerve individually is not sensitive to sound; but, while both are incapable of reacting to light and sound respectively, both, as is well known, may be excited by irritation from another source. The author is of the opinion, further, that subjective noises have their origin in an excitation of the terminal elements of the auditory nerve in the labyrinth, and that they may be traced in almost all cases to vibrations induced by the friction of the blood circulating in the labyrinthine vessels. These vibrations are communicated to the labyrinthine fluid, and thence to the terminal filaments of the auditory nerve, where they awaken the sensation of sound. These entotic



sound-excitations are probably always existent, but are too slight in the normal condition to be noticeable. A review of the intimate relations of the intra-cranial and intra-aural circulation, and of the modifications of the latter which may be effected by alteration in the intra-labyrinthine pressure, leads to the conclusion, first, that the amplitude of vascular vibration may be increased or remain unchanged; and, second, that the effect upon the auditory nerve may be increased either by reflection, concentration, or resonance. The first condition would be fulfilled by circumstances which increase the friction of the circulating blood, especially when the normal relations between the intra-vascular and intra-labyrinthine pressure are disturbed in anæmia or hyperæmia of the labyrinth, increased or diminished intra-labyrinthine pressure; partial compression or obstruction of the blood-vessels in inflammation, or when the character of the blood is changed, as in chlorosis. The intimate vascular relations between the brain and the labyrinth explain the common occurrence of tinnitus in cerebral disease preceding insensibility, as a premonitory symptom of an epileptic attack, and after the administration of such drugs as quinine, after profuse hæmorrhage, or in debilitating febrile diseases. As concerns the tinnitus resulting from intra-labyrinthine pressure caused by an incursion of the stapes, the author is of the opinion that the resulting symptom is to be traced rather to the effect of pressure on the intra-labyrinthine vessels than to immediate irritation of the terminal elements of the auditory nerve. The occurrence of tinnitus as a symptom in so-called chronic catarrhal inflammation of the middle ear and in obstruction of the external auditory canal by cerumen is explained as follows: "However much the subjective noises may vary in character in these cases, they are all characterized by pulsation which is increased by any means which increases the intra-cranial circulation; this points conclusively to the relation which the increased circulation bears to the tinnitus. The same obstruction, either a closure of the Eustachian tube or of the external auditory canal, which prevents passage of sonorous vibrations inward, prevents the same passage outward with greater consequent effect upon the auditory nerve; resonance here also plays an important part.



The Politzer experiment of allowing the sound of a vibrating tuning-fork placed upon the vertex to die away, and then recalling the sound by stopping one ear, is an illustration of this view. The variety of tinnitus in perforations of the membrana tympani is explainable by the passage outward of the vibrations which occur within the ear."

Following a description of the various forms of apparatus for the application of electricity and for testing its effects upon the human system, Itard takes up the question of tinnitus aurium, and divides this affection according to its causes into five different classes:

1. Tinnitus due to the presence of a foreign body in the external auditory canal or Eustachian tube.
2. Tinnitus due to inflammation of some one of the organs of hearing.
3. Tinnitus of vascular origin.
4. Tinnitus of nervous origin.
5. Tinnitus occurring without appreciable pathological change, and the origin of which is questionable.

The results as given of his observations on the use of the galvanic current, the rheophores being applied over both mastoid processes, may be summed up as follows:

1. The currents modify and localize the tinnitus.
2. Certain subjective sounds resist the action of the current longer than others; this is especially the case with a whistling sound.
3. The tinnitus diminishes in intensity with the diminution of the deafness, and disappears with the restoration of hearing.
4. The use of the galvanic current is sufficient to cure deafness of nervous origin; if this result is not attained, the hearing is at least improved.
5. A shorter period of treatment is necessary if the deafness is of recent origin.
6. A degree of relief is experienced immediately after the application of the current.
7. Only feeble continued currents should be used.
8. It is important not to fatigue the patient by too prolonged or too painful an application.

9. The more simple operative procedures give the best results.

Dr. Burnett reports three cases, which are of interest, as the tinnitus aurium and flushing of the face were probably the result of a central irritation of the sympathetic :

1. A young woman, twenty-six years of age, who had six years previously a right-facial paralysis of rheumatic origin, and had suffered for three years from deafness and a continuous tinnitus aurium. With excitement or exhaustion there occurred a decided twitching of the facial muscles, accompanied by a decided flushing over the cheeks and neck, and an increase of the tinnitus.

2. A small, spare woman, a farmer's wife, fifty-six years of age, experienced a sudden and excessive tinnitus aurium at the menopause; this diminished in time, but never entirely ceased. The hearing was not affected, but there was a peculiar vascular congestion or flushing coming on with any considerable excitement or fatigue, attended by an increase in the tinnitus, and extending from the ears simultaneously over each sterno-cleido-mastoid muscle forward toward the thyroid gland, where the blushes of either side coalesced and extended over the chest and mammae. At the same time a similar blush extended over the nucha and upper part of the dorsum, the rest of the surface being fallow. The tinnitus diminished under the use of strychnia ( $\frac{1}{60}$  gr. t. d.) for a month, but returned partially on discontinuance of the drug.

3. A large, strong woman, forty-five years of age, living in a malarial district, and pregnant with her eleventh child, has had an increasing deafness of both ears, with tinnitus, for several years. The membranæ tympani were opaque, and there was a peculiar vascular flush on the left cheek, corresponding to the ear most afflicted with tinnitus, aggravated by exertion, heat, or cold, and coincident with an increase in the tinnitus. This case improved under administration of strychnia ( $\frac{1}{45}$  gr. t. d.), and the daily use of the constant electric current for a week.

An interesting case of rupture of the membrana tympani is reported by Mr. Hewetson, and is worthy of notice from the peculiar circumstance of its occurrence :

The patient, a man, forty-eight years of age, applied for relief from deafness and severe tinnitus aurium. Inquiry elicited the fact that some four months previously the patient suffered from an unusually severe attack of vomiting, immediately following which he found that he could not hear his watch in the right ear, the hearing of which had always been previously good. On examination a small dark spot was discovered on the right membrana tympani, midway between the long process and anterior edge of the membrane.

Air forced into the middle ear gave no perforation-sound, but, after syringing with warm water, inflation was accompanied by a sharp, hissing sound, and the dark spot, freed of the slight accumulation of secretion, exhibited a ragged opening, the edges of which were everted by the stream of issuing air. Tepid instillations of a solution of the bicarbonate of soda, followed by use of a three-grain solution of sulphate of zinc, resulted at the end of a week in closure of the opening, and consequent improvement in the hearing. It would have been interesting in the above case to have determined the comparative potency of the two Eustachian tubes, as the rupture was evidently the result of the sudden intra-tympanic pressure consequent on the forcible vomiting.

During the past six years Dr. Knapp has observed seven or eight cases of fibroma of the lobule. These all originated from the point of insertion of the ear-ring and developed slowly after inflammatory irritation. These growths Knapp considers as an analogue of the chalazion and larger fibromata of the eyelid. It is generally observed that these tumors of the lobule are more common in negroes, and an attempt has been made toward explaining this fact on the supposition that they wear habitually larger and heavier ear-ornaments than do white women. According to the author, these growths occur principally on the posterior surface of the lobule, develop slowly and painlessly, and seldom exceed the size of a hazel-nut. In one case of a negress, twenty-two years of age, who had had the ears pierced two years previously, and dated the appearance of the tumors from that time, the fibroma of the right ear was as large as a hen's-

egg, that of the left ear as large as a hazel-nut. Both were removed with the knife.

Microscopic examination of the tumors showed a fibrous framework, with darker, more homogeneous interspaces. A canal filled with *débris* of tissue indicated the passage of the ear-ring. Fibrous trabecles radiated from this canal in various directions. They consisted of tough connective tissue, the fibrillæ of which lay close together, admitting only a few cells between them. The softer and semi-transparent interspaces between the trabecles contained a larger quantity of roundish, spindle-shaped, and stellate cells, which anastomosed with one another, and were separated by an abundant homogeneous or finely-striated intercellular substance. The author does not agree with the general opinion that these growths readily return, but holds that their return is the result of an inadequate extirpation—this view being supported in the above case, in which a portion of the tumor was left in one ear for the purpose of forming a better flap; four months later a recurrence was observable in this ear, while in the other ear, where the tumor had been entirely removed, there was no sign of a return of the growth.

The admirable character of the photographs which have become so well known in connection with the works of Prof. Rüdinger, and the success with which his use of this method of illustration has been attended, attach a value to the description of the very simple apparatus which he employs for mounting subjects for photographic copying. The apparatus consists of a disk, covered with black velvet, fastened to an upright by means of a double ball-and-socket joint, the upright being fastened in a heavily-weighted foot-piece. By this arrangement, the subject fastened to the velvet-covered face of the disk can be placed and maintained at any desired angle without the trouble of arranging either a background or a support.

Mr. Field proposes a modification of the Toynbee artificial membrana tympani, which shall make that instrument available for the application of medicated solutions. It consists in extending the wire one-quarter of an inch beyond the rubber membrane, and attaching a disk of fine flannel, be-

tween which and the rubber may be packed surgical cotton saturated with the medicated solution. The author claims for this instrument that the flannel gives the requisite pressure, the rubber assists vibration, and the cotton will allow of the continued application of any remedy which the case may demand. The same objects have been attained in the experience of the reviewer by the simple use of surgical cotton properly moulded and packed.

An ingenious and at the same time a very simple method for application of nitric acid in cases of granulations occurring in the middle ear or auditory canal has been devised by Dr. Buck.

One of the difficulties attending the use of this acid, when applied on the cotton-tipped probe, has been the liberation of vapor within the canal, obscuring the view, and interfering with the proper application of the acid. This is obviated by using a small glass tube, in which runs a platinum wire. The wire, tipped with cotton and dipped in acid, is withdrawn within the glass tube, the end of which is then pressed upon the spot to be cauterized, and the wire pushed forward. After the operation, the cotton may be removed from the wire by burning.

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## ASPERGILLUS GLAUCUS IN THE TYMPANUM, WITH A CASE.

By CHARLES H. BURNETT, M. D., PHILADELPHIA.

It is very apparent, from the writings of Politzer, Gruber, and Wreden, that an aspergillus, after attacking the fundus of the external auditory canal and the membrana tympani, may penetrate the tissue of the drum-head, and at last grow upon the mucous membrane of the tympanic cavity.

Prof. Politzer has narrated a case (*Wiener med. Wochenschr.*, 1870, 28) in which the aspergillus penetrated the tissue of the membrana tympani, so that it was possible to trace the mycelial filaments and the hyphens between the circular fibres of the drum-head.

Gruber<sup>1</sup> found the fungus in the middle ear of a rabbit, and Wreden ("Myringomycosis," p. 47), when alluding to the occurrence of aspergillus in the ear of man, says: "In some exceptional cases the membrana tympani, in consequence of excessive disease and neglect, may be perforated, and the parasite may ultimately grow upon the mucous membrane of the tympanum."

In all of these cases the preëxistence of the growth of the fungi in the auditory canal and upon the membrana tympani is either stated or implied; but that aspergillus may grow in the tympanic cavity of an ear, the drum-head of which has been previously destroyed by a chronic purulent disease, without making its appearance in the external auditory canal at all, is fully proven by the following case:

Miss M., eighteen years old, living in the best of hygienic surroundings, consulted me on October 10, 1872, respecting a chronic discharge from the right ear. The running from the

<sup>1</sup> "Lehrbuch d. Ohr.," pp. 316-319.



ear is attributed to teething, since which time it has existed. Upon inspection, a not copious, light-greenish, purulent, and odorless fluid was found in the fundus of the right auditory canal. The membrana tympani was destroyed, excepting small crescentic portions on a level with and extending backward and forward from the short process of the malleus. The manubrium was somewhat eroded. Hearing for watch reduced to  $\frac{3}{60} \frac{\text{in.}}{\text{ft.}}$ . By using astringents and syringing, the discharge ceased in about six weeks. The membrana tympani remained as it was found, but the mucous membrane of the tympanum became dry and pale, and did not appear thickened.

#### SECOND STAGE OF THE HISTORY.

About the 4th or 5th of July, six months after the healing of the ear, as above stated, the patient, while at her father's country-seat, took a bath in cold spring water, and, while in the bath, voluntarily splashed cold water against the side of her head, and into her previously diseased ear. This was instantly followed by a sharp pain in the right ear, which did not last long, but was followed by a bloody discharge, the first discharge of any kind from the ear since it was healed in December previous. The patient consulted me on the 7th of July. The membrana tympani was found still further gone, there being but a peripheral rim, and in place of the malleus there was a short, pendulous, and movable body, resembling the manubrium. By using a probe, this could be swung about, without causing any feeling to the patient. The mucous membrane of the inner wall of the tympanum, as far as was seen, was thickened and very red. The auditory canal was *entirely normal*.

A slight, purulent discharge came from the middle ear. The patient was ordered to use syringing and instillations of a two-grain solution of sulphate of zinc, thrice daily, under which the discharge ceased. In about a month, i. e., in August, 1873, the patient came with the statement that her ear was discharging again, but this time the matter was different from anything she had ever noticed before, as it was thin, transparent, and almost colorless. It was then found that a

pale-yellowish, serous fluid was coming from the ear, that the external auditory canal was entirely free from disease, that the tympanic cavity was congested, but there was no pain. The Eustachian tube was entirely pervious. The use of astringents and syringing was resumed, and faithfully carried out by the patient, who was extremely anxious to be free from the aural discharge; but, in spite of a variety of astringents, both in weak and strong solutions, the same thin, watery discharge continued to come from the ear. There was no pain or itching, except when the astringents were put into the ear; then itching would occur for a half-hour sometimes. The most that this treatment accomplished was a temporary cessation of the serous discharge for a week or two at a time; but it always came back. It never grew worse, but it never grew materially better. At last, on the 25th of May, about nine months after the first appearance of the watery discharge, the patient brought me a suspicious-looking pellicle, with dark-brown spots on it, which she said she had syringed from her ear, stating, also, that it was similar to others she had at times gotten from her ear, but of which no mention had ever been made to me.

I examined portions of this pellicle with the microscope, and found it composed of a dense mycelial web with the aërial fruit and free spores of *aspergillus glaucus*. The patient also informed me that she had removed similar spotted pellicles from her ear by means of a hairpin. She further offered to thus produce such if I would allow her to do it, then and there in my office. As I had examined her ear, and found by inspection nothing in the slightest degree resembling aspergillus, I became curious as to whether and how she could produce a specimen of the fungus for me. I therefore consented to her proposition; and, after she had bent a hairpin, at its curve, into a kind of miniature retractor, she passed it into her tympanic cavity. Turning her hook upward and backward, toward the mastoid antrum, she carefully and skillfully made a gentle turn with the instrument, and then withdrew it, giving herself no pain, and succeeding in removing, as she had said she could, a spotted pellicle, similar to that described. Instantly this was examined under the micro-

scope, and the aspergillus glaucus was found in various stages of growth.

The patient was then told to use three daily instillations of absolute alcohol on her affected ear, and to syringe the ear most carefully and thoroughly with warm water. Several days later the patient was seen; the pellicles came in numbers from the ear, and contained all the elements of aspergillus, but there were fewer free spores. The alcohol produced some burning when first instilled into the ear.

In the second specimens of pellicles from the ear beautiful octahedral crystals were found. Some of these crystals were imbedded in the mycelial mesh, others were clinging to the beautiful heads of aërial fructification. In one case, a delicate crystal seemed imbedded in the stem of one of the fruit-stalks. With the use of absolute alcohol and syringing, the watery discharge ceased, and the patient remained free from it long enough to pronounce the case cured; but, whether there has even been a return of the discharge or not, I cannot say, as I have lost sight of the case.

The etiology of this case of aspergillus in the ear is obscure. The specially interesting features are:

1. The fungus was not observed at any time in the external auditory canal, but apparently sprang up in the tympanum, in parts invisible to the observer from without. Since, in an ear in which the membrana tympani is intact, the aspergillus always seeks the deepest parts of the external auditory canal and grows on the membrana tympani, it can easily be comprehended how, if this fungus attack an ear in which the membrana tympani is destroyed, the vegetable parasite in its endeavor to find a secluded spot for growth would spring up in the tympanic cavity rather than in the external auditory canal. This same instinct of seclusion would also incline the aspergillus to seek those parts of the tympanum not easily visible or reached from without, as, for example, the inner surface of the remnants of the outer tympanic wall, the tegmen tympani, and the region of the mastoid antrum.

2. The only symptom, until the spotted pellicles were found, at all suggestive of aspergillus, was the thin, watery, serous discharge, which might, however, also occur without

the presence of aspergillus in the ear ; unless it be found that the chronic, slight, serous discharges from the tympanum, which sometimes occur in cases where the membrana tympani is destroyed, are found to be due to the unsuspected presence of aspergillus within the tympanic cavity. Although we have no data on this point, it will be of interest for future observations. I certainly think it is within the limits of probability. Wreden, of St. Petersburg, has recently demonstrated, by collecting histories of cases of aspergillus in the ear, from various sources, that this fungus is apt to attack ears which have been but are no longer the seat of active inflammatory disease. It would be easy to understand how the aspergillus might attack a tympanum in which a chronic purulent disease had been cured ; but, by attacking the ear very soon after the purulent disease had disappeared, it might be mistaken for a simple return of the original disease, and the treatment resorted to in such a case, as it appears from this one under consideration, would not be sufficient to kill the fungus. In such a case the discovery of some portions of the fungus might be the only true guide to proper treatment.

3. In this case it must be supposed that the fungus either existed prior to the time I first saw the patient, or that it sprang up during the time she was under treatment for chronic discharge from her ear. If it already existed, then syringing and instillation of ordinary solutions of astringents are unable to destroy aspergillus in the tympanic cavity, no matter how potent they may be to kill it when found in the external auditory canal. On the other hand, if the fungus growth took place in the ear while the patient was under the above-named treatment, then the latter was entirely unable even to prevent the parasite from getting a hold in the ear. It is very certain, however, that, when the presence of aspergillus was found out, alcohol instillations were the only means which destroyed this troublesome parasite, and banished it from the tympanum.

## PRIMARY ACUTE PERIOSTITIS OF BOTH MASTOID PROCESSES.

BY H. KNAPP, M. D., NEW YORK.

NINE months ago Voltolini described some cases of independent acute inflammation of the subcutaneous tissue of the supra-auricular and post-auricular region, and Dr. Cl. J. Blake, in his review of Dr. Voltolini's paper, added a case of his own experience.<sup>1</sup> The symptoms, briefly enumerated, are: Inner and middle ears free; external auditory canal either unaffected or showing some redness and swelling in its posterior part; post-aural region red, shining, tender, swollen; severe pain; fever. Resorption may take place; if not, spontaneous opening may occur in the mastoid region, the posterior wall of the auditory canal, and in the neck two or three inches below the mastoid process. Voltolini thinks that the common cause of the disease is exposure to cold, and points out that the post-aural region may be considered as particularly susceptible because, being devoid of hair, it is less protected than the scalp. He mentions that the disease sometimes occurs on both sides, and states that he observed it in Silesia only, while in his former dwelling-places, Pomerania and Berlin, he never saw it.

Last winter a typical instance of this affection came under my care here in New York City. It exhibited the symp-

<sup>1</sup> R. Voltolini: "Die acute Zellhautentzündung in der supra- und post-auricular Gegend." *Monatssch. f. Ohrenh.*, December, 1875, p. 139.

Cl. J. Blake: "Otological Review," *Archives of Ophthalmology and Otology*, vol. v., p. 287, etc.



toins so well, and its course proved so instructive to me, that I would beg leave here to report it:

Miss H., aged twenty; had never been ill, and her ears, in particular, had never given her any annoyance. Early in March, 1876, she had some pain in her left ear, worse at night than during the day. Her hearing did not suffer. Soon the skin behind the ear became red, swollen, and tender to the touch. She was treated by her family physician, a homœopathist, with internal remedies. The disease grew worse from day to day, with this peculiarity, that the pain, which at first had been in the ear, was soon located in and confined to the post-auricular region and the adjacent part of the neck. When I saw the patient (March 14, 1876), a week after the commencement of the affection, she was feverish, had no appetite, kept her bed, and suffered intense pain behind her left ear and in her neck. The mastoid region was swollen, shining, red, and very tender to the touch. The skin on the posterior surface of the auricle was red, swollen, and raised. The external meatus and membrana tympani were in a healthy condition. Hearing excellent, and equal on both sides. The upper part of the sterno-cleido-mastoid muscle, from its insertion into the mastoid process downward to the extent of about an inch, was swollen and painful to the touch; whereas, the neck, in the further direction of the muscle, was painless. There were no cerebral symptoms. From reasons I shall state hereafter, I did not doubt that I had to deal with a periostitis of the mastoid process. No fluctuation yet being present, I ordered leeches behind the ear, prescribed morphia for the night, and an aperient for the next morning. This treatment was continued for four days, since I thought resolution might still be possible. The affection, however, grew worse every day, the pain was more severe, the swelling and redness of the skin more pronounced and extensive, reaching two inches down the sterno-mastoid muscle. The jugular vein in its entire course was not tender to the touch. The fifth day after my first visit—that is, the nineteenth after the beginning of the disease—fluctuation could be felt behind the ear; and, therefore, I hesitated no longer in making a vertical incision, three-fourths of an inch in length, down to the bone of the

mastoid process. A small quantity of pus was liberated. I ordered poulticing for two to three hours daily. Patient passed a comfortable night, had but little pain, and felt relieved in every respect. The swelling and tenderness of the post-auricular region and the upper part of the sterno-mastoid muscle had diminished. The wound discharged freely. With a probe a smooth surface of bone was felt. Under the application of cataplasms for several days, the swelling rapidly diminished. The discharge ceased in four days, the wound closed, and hardly left a scar. Ten days after the incision the disease was cured. During the entire course of the disease no symptoms on the part of the hearing organ were noticed: neither dullness of audition, nor tinnitus, nor disturbance of equilibrium. The drum-head had always been normal. The region behind the ear, however, as far as two to three inches backward from the auricle, was somewhat tender and susceptible to cold for three months.

On the 24th of April—that is, eight weeks after the beginning of the disease on the *left* side, or three weeks and a half after its termination—the patient, without any exposure, felt great pain behind her *right* ear and over her head. The next day the skin behind the ear was red, swollen, and tender. The third day these symptoms were aggravated, and the patient, who was visiting friends at Troy-on-the-Hudson, at once returned to New York, feeling convinced, from the identity of the symptoms, that the same disease had affected her right ear. I saw her in the evening, and could but confirm her conclusion. I ordered leeches behind the ear, and a quarter of a grain of morphia for the night. The next day she felt worse, the post-aural region and the upper part of the sterno-mastoid muscle were swollen and painful. The following day these symptoms were more marked. Though there was no fluctuation, I made an incision behind the ear down to the bone. No pus escaped. I ordered poultices to be applied for an hour. Soon after the incision the patient felt better, the night was comfortable, the swelling and redness diminished, the pain had disappeared, and in five days the disease was cured. There has been no relapse. The external auditory

canal, the membrana tympani, and the other parts of the ear had not been implicated.

I beg leave to add some remarks to this case. To Dr. Voltolini belongs the merit of having given a detailed description of this affection. The *idiopathic* external inflammation of the mastoid process has, as yet, no place in the text-books, and even our colleague, Dr. A. H. Buck, in his elaborate paper on the diseases of the mastoid process in the *Archives of Ophthalmology and Otology*, vol. iii., No. 1, p. 179, states that "the inflammation of the external periosteum of the mastoid process occurs as a concomitant symptom or phase of an acute inflammation of the external auditory canal." The symptoms are well described by Voltolini, with the exception of one which he does not mention, but upon which I would lay particular stress, I mean the *swelling of the upper part of the sterno-mastoid muscle*. Every one of us will recollect, from the dissecting-room, how intimate and extensive is the connection between the sterno-mastoid muscle and the mastoid process. An inflammation of the periosteum is doubtless easily propagated to the muscle, and the main inflammatory product, pus, will readily find its way into the muscle, and, by traveling down the neck, form abscesses by gravitation and the fistulous canals of which Voltolini speaks in one of his cases that terminated fatally. I have several times noticed this swelling of the upper part of the sterno-mastoid process, and have always held it characteristic of external inflammation, i. e., periostitis of the mastoid process. In internal inflammations of the mastoid, with caries and post-aural abscesses, which we see so frequently, this symptom is either absent or little marked.

In regard to the differential diagnosis of the disease under consideration, the swelling of the upper part of the sterno-mastoid muscle serves, furthermore, to distinguish periostitis from cutaneous and subcutaneous inflammations, since these affections, it seems to me, will extend more or less diffusely over the skin and subcutaneous tissue of the neck, instead of producing a hard, painful, and circumscribed swelling of the upper part of the muscle. Voltolini asserts that, in his cases,

there was no periostitis, but an inflammation of the subcutaneous tissue, a so-called pseudo-erysipelas. Since he does not mention the circumscribed swelling of the head of the sterno-mastoid muscle, the diagnosis in his cases may have been correct; to the case related by me it does not apply. In this the diagnosis periostitis is furthermore corroborated by the observation that thin pus was liberated only when the knife had penetrated down to the bone.

The intense headache, the fever, and the swelling in the upper part of the sterno-mastoid muscle made me, for a moment, suspect a grave cerebral complication, in particular phlebitis and thrombosis of the cerebral sinuses, so much the more as, according to Griesinger,<sup>1</sup> obstruction of the emissarium in the sigmoid fossa produces a painful oedema, limited to the region of the mastoid process. But, since there was neither induration nor swelling of the jugular vein, and the middle ear was in a healthy condition, I could not long entertain the suspicion of an internal affection.

A remarkable feature of our case, and the disease which it exemplifies, was the independent affection of *both* mastoid regions. I cannot account for this fact, though we know that independent affections of symmetrical organs in different parts of the body are no rarities, yet the connecting link, as far as my knowledge goes, has not yet been discovered, not even in so common and dreaded a disease as sympathetic ophthalmia.

The spontaneous *course* of the periostitis mastoidea seems to result in suppuration and its consequences: abscesses, fistulous canals, etc. Spontaneous resolution has not been observed.

The *prognosis*, if the difficulty be allowed to run its course i. e., with no treatment, is not devoid of great danger, as the fatal case of Voltolini demonstrates. If, however, an early and deep incision removes the tension of the periosteum and liberates the pus, recovery seems to be the constant termination.

The *treatment* may be antiphlogistic as long as the nature

<sup>1</sup> See S. Moos, "Klinik der Ohrenkrankheiten," p. 253. Wien, 1866.

of the affection is not plainly pronounced and resolution appears possible, yet, from what we have hitherto observed, we must derive the conclusion *that, the more early a bold and deep incision, down to the bone, is made, the more certain and speedy will be the recovery.* The wound should be kept open, and poultices applied, as long as suppuration is present. I need not speak of the treatment of complications, since it has to be conducted on general principles.



## A CASE OF EXOSTOSIS OF THE EXTERNAL AUDITORY MEATUS DRILLED OUT BY THE "DENTAL ENGINE."

By ARTHUR MATHEWSON, M. D., BROOKLYN, N. Y.

THE following case is presented as worthy of record from the fact of its being one of the very few cases of exostosis of the auditory meatus successfully removed by surgical operation, and because it illustrates a new and, as it seems to me, better method of operation—namely, the application of the "dental engine," or lathe.

The class of cases to which it belongs is not unimportant, for aural exostosis may not only impair the hearing but endanger life. The patient was the one whose previous history is given on page 407 of Dr. Roosa's treatise on "The Diseases of the Ear."

Miss M. M., aged twenty-five, small, delicate, and subject to neuralgic pains, but in fair general health, was put under the influence of ether in March, 1873, for the purpose of thoroughly examining, and, if practicable, removing a tumor blocking up the right external auditory canal. The examination was conducted by Dr. Loring, under whose care she was, assisted by Drs. Roosa and Pardee.

"The tumor arose from the posterior portion of the osseous canal of the right ear, and nearly occluded the passage. There was a minute opening between it and the anterior wall, through which a No. 2 Bowman's probe could be passed into the cavity of the tympanum. The tumor was of bone, and covered by a movable integument, which was red, and very sensitive. On passing the probe into the minute opening that

has been mentioned, it could be passed under the growth, and, when pressed upon, the growth was seen to move slightly.

"The history of the case was, that there were frequent attacks of pain in the ear, without discharge, until the patient was eleven years old ; since which time there has been no 'true earache,' although the parts are tender, and there is a great feeling of fullness in the ear. The watch is not heard at all on the affected side." The voice was heard very imperfectly. At this time Dr. Loring, using one branch of a pair of short, straight scissors, passed in with a boring motion through the opening by the side of the tumor, and removed some of the soft tissue covering the exostosis. On May 8, 1873, as there was considerable pain in the depth of the ear, Drs. Loring and Roosa advised that some operative means be taken to remove the growth. After a time, however, there was a cicatricial shrinking of the soft tissues attacked by Dr. Loring, so as to leave the opening larger and the hearing much better.

The case went on without serious symptoms until the winter of 1875-'76, when she began to experience a sense of pressure in the head, and had attacks of loss of consciousness, and other cerebral symptoms, recurring at intervals until the time of the operation in May. Dr. Loring had seen her at intervals, and advised an operation, intending, he has told me, to resort to the same method as was employed by me ; but, as she came to reside in Brooklyn, kindly referred her to me for further treatment.

I found the meatus nearly occluded by the exostosis, over which the integument was thin and very sensitive. The growth had become immovable, and had evidently increased somewhat since the time of Dr. Roosa's report. There was no discharge. The hearing was much impaired.

The history of similar cases showing that they sometimes have had a fatal termination, and the symptoms in this case seeming threatening, an operation for the removal of the growth, or the formation of a larger opening in the meatus, was urgently advised, and finally consented to. It had occurred to me, at my first examination of the case, that the engine used by dentists in their operations might be satisfactorily employed for the purpose. The machine used was that

known as Elliott's suspension dental engine, shown in Fig. 1, in which the power is supplied by a treadle worked with the

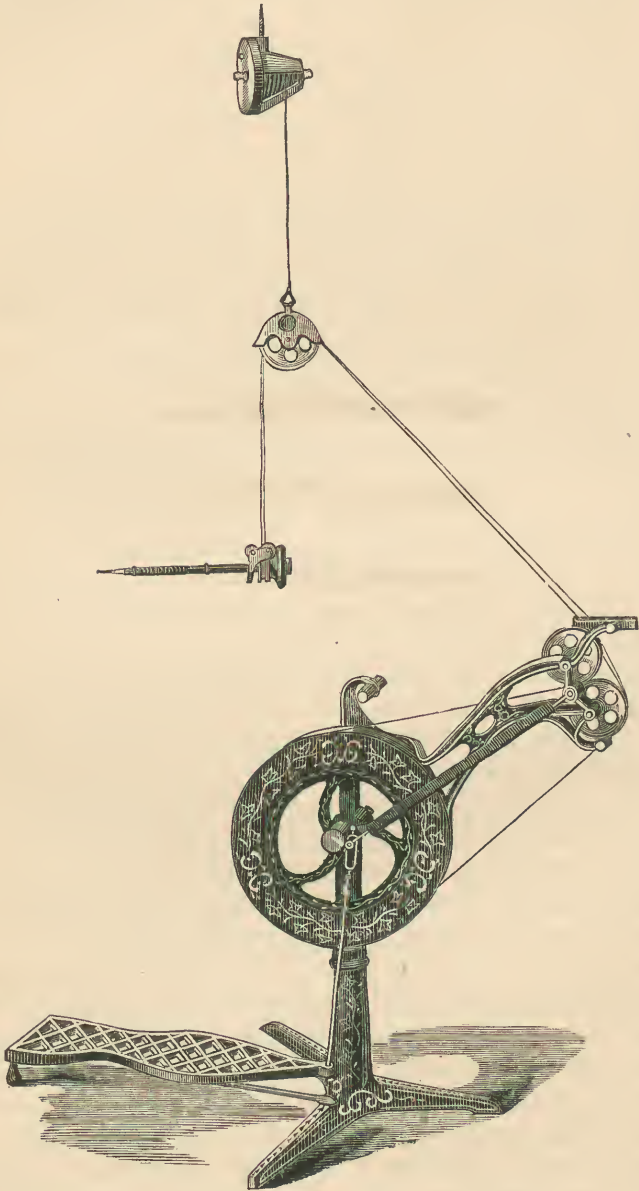


FIG. 1.

foot, while the hand-piece, to which the burrs or drills are attached, held like a pen, can be raised or lowered, and turned in any direction desired.

Under the instruction of my friend Dr. William Jarvie, dental surgeon, I experimented with this engine on teeth and bone, so as to get some appreciation of its power, and of the proper degree of pressure in applying it. Dr. Jarvie also ground the burrs figured to a form which seemed best adapted to the work proposed—to use the technical terms, making a square drill out of a fissure burr. The engine was set up under his supervision, and arranged properly with reference to the height and position of the bed on which the patient was to lie during the operation.



FIG. 2.

The operation was performed, May 21, 1876, with the assistance of Drs. Rushmore, Colton, Cornwell, and Jarvie, the latter working the treadle of the engine with which his daily practice had made him familiar. The patient was under the influence of ether. The meatus was illuminated by a mirror on the forehead of the operator. The first step was to remove the integument covering the growth, that it might not clog and impede the action of the drill. This was done by another dental instrument known as the scaler, the skin being circumscribed and scraped off with it. The bony growth was then perforated at several points near its centre with the smallest of the drills, about one and a half mm. in diameter, which penetrated without difficulty, with so slight a pressure, that there was but little danger of its slipping forward and injuring the deeper parts, though the growth was eburnated and excessively hard. The larger drills (two and a half and three mm. in diameter) were next used successively to enlarge the

perforations and run them together, and by lateral pressure to ream out the meatus.

There was so much bleeding that I was obliged, in spite of frequent swabbing with styptic-cotton, to depend much on the probe for guidance in the operation. The excavation was continued cautiously till the largest drill—about three mm. in diameter—passed freely through, with room to spare, and the probe could be carried in the whole length of the meatus. Besides using the styptic-cotton on cotton-holders, the meatus was repeatedly syringed during the operation for the removal of blood and *débris* of soft and bony tissues.

The operation occupied twenty to thirty minutes. No troublesome hæmorrhage followed, and the pain experienced by the patient on recovery from the influence of ether was easily subdued by the warm-water douche and moderate doses of opiates. A purulent discharge from the meatus soon came on, for which a weak solution of sulphate of zinc was used, at first after syringing, and later the parts were touched with solutions of nitrate of silver. For weeks after the operation the meatus was so nearly filled with swollen and granulating soft tissues that nothing could be seen of the membrana tympani, but examinations with the probe showed that a considerable opening in the hard structures existed. Gradually, and with occasional applications of nitrate of silver, these soft, granulating tissues thinned down, till now there is an opening of nearly the full size of the meatus, except at one point where there is a thin remnant of the exostosis projecting from the anterior upper wall of the meatus. The posterior lower part of the membrana tympani can be seen.

All discharge has ceased ; there is no irritation or unpleasant symptoms of any kind, and the hearing has risen to nearly the normal standard.

In connection with the foregoing case, a brief *résumé* of the history of the therapeutics of exostosis of the auditory meatus may not be inappropriate.

Toynbee reports nine cases, one of which was treated by local applications of strong solutions of nitrate of silver frequently repeated for a long period, with the ultimate result of



a perceptible diminution of the tumor, due, as he thinks, to decrease in thickness of investing membranes.

In another case the size of the growth was diminished and the hearing improved by the application of the tincture of iodine to the tumor and behind the ear, with the internal administration of iodide of potassium in four-grain doses, repeated thrice daily between two and three months.

Wilde recommends in the earlier stages of the growth, when it is the result of chronic periostitis, counter-irritation, bleeding, and bichloride of mercury internally, but has not much confidence in treatment when the growth is farther advanced.

In one of the cases of exostosis reported in Dr. Roosa's work, it is stated by the attending physician that "any increase of the impairment of hearing is always relieved by an application of the tincture of iodine to the bony growth."

Gruber, in his book, published in 1870, reports no case, but says in general that the prognosis is unfavorable with all the means of treatment hitherto applied. The soft tissues covering the tumors may be diminished, but not the bony mass itself. Compression by bougies, he thinks, could not, in most cases, be endured.

Von Tröltzsch reports a case in which a laminaria bougie, introduced for the purpose of dilating the meatus, could not be removed for two months. Small sequestra came away, and the passage was so enlarged that the hearing was restored.

One of the cases of exostosis recorded by Dr. Roosa was treated while in London by Toynbee with bougies to dilate the meatus, but they caused much pain, and accomplished nothing. Besides causing great suffering and aggravating the symptoms of pressure, it is logical to suppose that bougies would as readily cause necrosis of the walls of the meatus as of the exostosis. The last-mentioned case had afterward a fatal termination from retention of pus.

The first reported case of surgical operation on exostosis of the auditory meatus is the celebrated one of Bonnafont, of which there is an account in *L'Union Médicale*, May, 1868. The growth filled up the meatus and obstructed the hearing. The soft tissues over the bony growth were first

destroyed by applications of nitrate of silver for five or six days, and then the attempt was made to bore through the bone with a fine rat-tailed file. It was only at the fourth sitting, and after causing much pain, that he succeeded in gaining a starting-point for the end of the file. The boring was continued for ten days. After each sitting a whale-bone probe was introduced to maintain the opening gained. The perforation finally made was still open some years after with satisfactory results in improvement of hearing.

Since this case of Bonnafont's, the following cases of operation have been reported: Dr. L. B., of Hamburg, relates, in the *Archiv für Ohrenheilkunde*, vol. x., p. 110, the history of his own case. Having been troubled at intervals for several years with deafness and tinnitus, caused by the presence of exostoses in each auditory meatus, operations were begun by Dr. Knorre, in July, 1873, with a drill—kind not stated—and continued for four days, with much pain, caused by slipping of instruments and inflammatory reaction of meatus. After a pause of two days an unsuccessful attack on the growth with a chisel and hammer caused severe headache. In ten more sittings, in which forceps as well as drills were used, small pieces of bone of cancellated structure were brought away, the operation being attended with great pain. Muriatic and sulphuric acids were next applied to the tumor for eight weeks two or three times a day with small effect. The actual cautery was applied several times. After a cessation of treatment, when the swelling of the soft tissues had subsided, it was found that a probe could be passed between the tumor and the walls of the meatus. On the 29th of October the patient began to operate on himself with a small, blunt file, roughened only on one surface, which could be introduced along by the side of the growth, and continued filing at it at intervals till the end of the following January. An opening, through which a pretty thick probe could be passed, was finally attained with restoration of hearing and relief of tinnitus. He states that the sensitiveness of the parts increased after each operation. Probably few patients could be found to voluntarily endure so long a course of suffering.

In a note to this case, Schwartze states that two cases of

successful operation on exostosis of the auditory meatus by chisel and hammer had recently come to his knowledge, but gives no details. Whether they are the same as the two reported by Aldinger, of Fürth, near Nuremberg, in vol. xi., part ii., of the *Archiv für Ohrenheilkunde*, does not appear. The latter were both performed on the same subject by Prof. Heinecke in 1875. Exostosis had first been found in both ears of a middle-aged man eight years before, and had grown slowly till 1874, when the right meatus was completely filled, and the hearing abolished. In December, 1874, severe pain came on in the right ear, and four days later profuse discharge of pus. On the 2d of January following, the indications for the removal of the growth seeming urgent, Prof. Heinecke made an attempt to cut through the base of the tumor with a gouge three lines in breadth, driven by heavy blows of a hammer. It was unsuccessful on account of the hardness of the growth. After repeated efforts, several small fragments were chipped off the edge of the exostosis, so that a sound could be passed through to the membrana tympani. Other fragments were removed by the forceps during the next ten days, and the caliber of the meatus opened to half the normal size. The membrana tympani was found perforated; granulations which formed were removed by the snare, and treated also with astringents and applications of nitrate of silver. In March, 1876, the opening in the meatus was stated to be four lines by two; the perforation in the drum membrane closed and the hearing was completely restored.

In August, 1875, the left ear of this patient became completely deaf and painfully inflamed in consequence of the growth of the exostosis on that side, and Prof. Heinecke operated for its removal with gouge and hammer on the 25th of October, 1875. Setting the gouge near the base of the tumor, he succeeded in starting a considerable piece of the growth by repeated powerful blows with the hammer, and prying it off so that it was removed by the forceps. Several small pieces were chipped off, and a free passage opened through the meatus. On the third or fourth day after the operation there was great pain in the ear, and a sense of pressure in the occiput. In March, 1876, the opening in the meatus remained,

though smaller than it had been at one time after the operation, and the hearing was very good.

Voltolini has suggested the application of galvano-cautery to the periosteum of exostosis, with the hope of causing it to be thrown off. According to Schwartze's experience, there is danger to the walls of the meatus, from slipping of the galvano-caustic noose from the smooth surface of the growth.

In a note to Aldinger's paper, the editor of the *Archiv* refers to a case of exostosis reported by Hinton, which had been operated on by Clark, of Clifton, England, with the constant galvanic current. He says, briefly, "After two applications of three needles under chloroform, the exostosis came away in mass, and the patient heard again; entirely well." There is no history of the size or shape of the growth, or of its attachment, but it seems hardly probably that such a result could have been attained in a broad-based, eburnated tumor.

In comparison with any of the methods of operation employed in the cases collated, that with the dental engine seems to me the best, as being less tedious, less dangerous, and more effective. That it is less tedious, a few tests of this and any hand-drills in perforating dense bone will demonstrate. It is less dangerous for the reason that, with the rapidly revolving drills, perforations can be quickly made with so slight a pressure that there is little risk of injuring the deeper parts of the ear, or the walls of the meatus, by the slipping so likely to occur in operations with hand-drills, or with hammer and chisel. The instrument is also held between the thumb and fingers in such a way as to interfere to a less degree with the illumination and inspection of the meatus during the operation. The drills and burrs can also be used, not only to perforate with their points, but also to enlarge openings, already made, to any desired extent or direction by lateral pressure with their sides.

Other uses for the dental engine in surgery readily suggest themselves. There is a great variety of burrs, drills, and saws—more than three hundred in all—figured in the manufacturer's catalogue, which can be attached to the engine, and would be of great assistance in operations on bony

growths occurring elsewhere, like those of the orbit, in some cases of resection, and in any case where there is small space to employ the ordinary instruments effectually without endangering the neighboring parts. The form of dental engine which seemed to me best fitted for the purpose is that figured, known as Elliott's suspension engine, the price of which is fifty dollars. Another form called the Morrison engine, which costs only twenty-five dollars, can be set up without the necessity of screwing a fusee into the ceiling, as is the case with the suspension engine, and for most surgical purposes may do sufficiently well. These engines and their attachments can be seen at Johnston Bros., 812 Broadway, New York.

There is no necessity, however, for the surgeon to increase his armamentarium—already perhaps too large—by the purchase of an instrument so costly, as most dentists are now provided with them, and their services can be readily engaged for special occasions.



## TEST-SENTENCES FOR DETERMINING THE HEARING POWER.

BY ALFRED H. BUCK, M. D., NEW YORK CITY.

(PRELIMINARY COMMUNICATION.)

THERE are two tests in common use for estimating the acuteness of a person's hearing. These are the ticking of a watch and spoken or whispered words or sentences. Both of these tests, as is universally admitted, are unsatisfactory in many cases. Thus, for example, the patient may be able to distinguish the ticking of a watch at a distance of several inches, and yet he may have the greatest difficulty in understanding ordinary conversation; on the other hand, he may not be able to distinguish the ticking of a watch at all, but he will readily understand spoken language. Such contradictory results render the watch a very untrustworthy instrument for measuring the hearing.

When a person, who is suffering from deafness, applies to a physician for relief, his principal object is, not merely to regain the power of hearing certain delicate sounds (like the ticking of a watch), or of clearly and accurately distinguishing each individual tone in the musical scale, from the lowest to the highest, but rather to secure an improvement in, or a restoration of, the power to understand spoken language. If the physician, therefore, wishes to watch with some degree of accuracy the effect of his treatment, he must, in some way or other, utilize speech as a means of determining the changes in the acuteness of his patient's hearing. The usual method of doing this has been to ascertain at what distance the patient could hear correctly any arbitrarily chosen words (usually numbers) or sentences repeated by the physician. Those who

have used this test, however, are well aware of the difficulties with which it is surrounded—difficulties which have led many physicians, at least on this side of the Atlantic, to abandon it altogether.

In the first place, it is difficult always to use the voice at the same pitch and with the same intensity on all occasions. This difficulty, though, can be very soon overcome by practice. In the second place, most of our houses are so small that we cannot obtain the necessary amount of space for employing the voice-test in a very accurate manner. In most of our city houses, however, it is possible, in one way or another, to secure an open space of about forty-five feet in length. This length we are compelled to adopt as our normal limit of distinct hearing for ordinary spoken language. While it falls short of the normal limit by a great many feet, we may, nevertheless, assume that, if a patient can distinctly hear language spoken in an ordinary distinct tone of voice at a distance of forty-five feet, his hearing is sufficiently acute for him to dispense with the professional assistance of an aurist. A third difficulty lies in the great differences in words as regards their penetrating power, some being heard easily at a great distance, while others can only be distinguished with difficulty a few feet off. Take, for an example, these very words, “distinguished” and “difficulty,” and it is easy to understand how a patient, who can hear such words as “alarm,” “mortality,” and “adviser,” the full length of our assumed normal limit, would, perhaps, not be able to hear these less penetrating ones correctly at a distance of more than fifteen or twenty feet. Hence, if spoken words or sentences are to be employed as a test of the changes in acuteness of hearing, it is desirable that some attempt should be made to group a certain number of sounds (vocal), words, or sentences in classes, all the members of any one group or class being—as nearly as it is possible to make them—equal in value as regards penetrating power. If such a series of tests could be prepared, we would be able, at suitable intervals of time, to subject the acuteness of hearing for spoken language to a test which might be considered as reasonably free from the objections just enumerated. In other words, we should feel that, upon each occasion

of testing a patient's hearing, the component factors of the test were practically the same. Now, while it may not be possible to prepare for use in practice any set of sentences, words, or syllables, which can be considered as equivalents in a strict scientific sense, few, I believe, will deny that something of this kind is needed, even if it should fall decidedly short of scientific accuracy.

While I am not prepared to offer such a series of tests as might be of use in actual practice, I would, nevertheless, offer the following four sentences as examples of what may fairly be termed equivalent test-sentences—that is, they each contain eight long-vowel sounds, and are equally free (or very nearly so) from non-resonant, consonant, or short-vowel sounds :

1. Pour oil on the waters of Lake Erie.
2. All hail ! thou hero of fourteen wars !
3. John wants the brown mare to be shod now.
4. He lies here in awe of these four large tigers.

These sentences are, of course, absurd in themselves, but they serve to illustrate how groups of words may be formed which can fairly be considered as equivalent in penetrating value. If we compare them with the following four sentences, their greater richness in long-vowel sounds will be at once apparent :

1. Beneath the canopy of the heavens.
2. Singing to many practitioners.
3. Manœuvring in the depths of the abyss.
4. Oscillating particles of matter.

For actual use in practice, it would be necessary to have at our command a much greater number of sentences, as it would not be safe to use the same ones twice with the same patient. At each test it would also be well to determine the hearing distance, not with a single sentence, but with four or five ; the average distance of the several tests made at one time being the proper one to place on record, as a measure of the hearing distance at that particular time.

## TWO CASES OF ACUTE INFLAMMATION OF SCHRAPNELL'S MEMBRANE.

BY ALBERT H. BUCK, M. D., NEW YORK CITY.

CASE I.—W. C., aged thirty-three, policeman, sought relief March 10, 1874, for a very annoying tinnitus in both ears. No pain; no deafness. Trouble began about two months previously. Hearing distance for watch = R.  $\frac{6}{15}$ , L.  $\frac{6}{15}$ . Both tympanic membranes dull, slightly sunken; some redness of Schrapnell's membrane on the left side.

*March 14th.*—Painted left Schrapnell's membrane with a solution of nitrate of silver, gr. 120, Aq.  $\frac{3}{4}$  1.

*March 16th.*—Tinnitus worse in the left ear; constant ringing of bells. There is also some pain in the left ear, though he says it is only slight. Nevertheless, the man has the appearance of a person in suffering; he makes light, I think, of his pain. Hearing distance for watch  $\frac{3}{15}$  (three feet). Schrapnell's membrane red and glistening. Through the upper and posterior portion of the membrana tympani, which is still translucent, a circumscribed yellowish region can be made out. It conveys to the eye the impression of some yellowish body projecting downward from the inner side of the axis-band of the hammer. Suspecting the existence of an accumulation of pus, I made an incision into the red tissues of Schrapnell's membrane just above the post-sup. quad. of the M. T., i. e., just above the yellowish region seen through the M. T. A drop of pure, thick pus followed the incision. A second incision into the anterior portion of Schrapnell's membrane, which was also somewhat red, gave escape only to blood.

Inflation by Politzer's method exerted no influence whatever on the contents of the abscess. After the immediate pain of the incisions had subsided, the patient expressed himself as feeling greatly relieved in the condition of his head.

*March 18th.*—No discharge has occurred since operation.

*March 23d.*—Very little tinnitus remains in the left ear.

CASE II.—Mrs. O., aged *circa* thirty; healthy. On the 18th of April, 1876, she began to suffer from pain in the right ear. Her physician examined the ear, and, finding it filled with a plug of cerumen, he removed it by syringing. During the following three days she continued to suffer from pain in the ear, the pain not being constant, but coming on in paroxysms, with intervals—which sometimes lasted for several hours—of complete freedom from pain. The pain, however, when it came, was of very great severity, especially on the 21st of April, the day on which I saw her. At this time I found the meatus in a normal condition; the M. T. was beginning to be slightly œdematous (like polished steel when breathed upon), but not visibly reddened; Schrapnell's membrane red and somewhat swollen, especially posteriorly, but without anything like "painting." Hearing distance for watch  $\frac{1}{15}$  (twelve inches).

A free incision (*circa* four mm. in length) into posterior portion of Schrapnell's membrane caused quite a large drop of pure, thick pus to almost gush out through the opening.

I did not see the case again, but the physician reported that the operation gave complete relief, and that very little, if any, discharge made its appearance afterward.

*Remarks.*—As a rule, it is neither a safe nor a very profitable thing to report and draw conclusions from only two cases of a disease. In the present instance, however, I think it is better not to wait for the opportunity of seeing other cases of the same nature—an opportunity which may not present itself in years—but rather to call the attention of my colleagues to the subject at once, in the hope that in this way a sufficient number of cases may be the more rapidly accumulated.

Every aurist sees a certain number of cases of otorrhœa in which the only demonstrable lesion of any importance is an ulcerated opening in the posterior half of Schrapnell's mem-



brane, from which a fistulous track leads inward a variable distance, and at the bottom of which the probe usually encounters denuded bone. Sometimes this opening is so extensive that the neck and head of the hammer lie exposed to view. The peculiarity of these cases, however, lies in the fact that the membrana tympani is still entire, and, in many cases, not adherent to the inner wall of the tympanum. Inflation, too, either by Politzer's method or by means of the catheter, reveals the fact that the cavity of the tympanum contains no fluid, and has no communication with the fistulous cavity. In other words, the trouble is a chronic caries of a limited region of bone in the immediate vicinity of the middle ear; but it differs from all the more common forms of caries encountered in this region in the fact that the pus and detritus thrown off from the diseased part do not escape by way of the tympanum, but through a sinus which, though appearing to lead directly into the middle ear, has no communication whatever with this cavity.

If I am not mistaken, it has been customary to explain these cases on the supposition that originally there was an inflammation of the entire middle ear, with a perforation in Schrapnell's membrane, but that gradually the inflammatory process became restricted to the tissues occupying the upper and posterior portion of the cavity, the wall of separation formed by the healing process being so perfect as to entirely prevent any of the inflammatory products from entering the middle ear. In a word, these cases have been looked upon as cases of an imperfectly healed purulent inflammation of the middle ear.

The two cases I have just reported suggest the idea that the pathology of this class of cases may be a different one; that is, that at the outset the inflammation may have been restricted to the soft parts constituting, and lying near to, the posterior half of Schrapnell's membrane. As the descriptions of these two cases show, such a circumscribed inflammation of Schrapnell's membrane does sometimes occur, and, such being the fact, is it not more natural to explain these cases of fistulous opening in Schrapnell's membrane as *ab initio* cases of

circumscribed inflammation?<sup>1</sup> Further observations of such cases will undoubtedly furnish us, in due time, with a satisfactory explanation of their pathology.

Finally, let me draw attention briefly to the question of diagnosis in these acute forms of inflammation of Schrapnell's membrane.

In the first case, I interpreted the yellowish appearance seen through the membrana tympani as indicating a swelling (due to the presence of an abscess) of the inner side of Schrapnell's membrane. The patient, it is true, did not complain of serious pain, but his haggard countenance and excited state of mind (repeatedly asking me if the trouble were not in his brain instead of in the ear) showed clearly that some serious disease was present. At the same time, I was not a little surprised to see pus follow the incision.

In the second case, owing to the knowledge gained in the first case, I felt quite confident that pus had either already formed, or would speedily form, in Schrapnell's membrane, unless the knife were used.

The points which favor the diagnosis of an abscess in Schrapnell's membrane—so far, at least, as can be gathered from my two cases—are the following:

1. The well-marked redness of Schrapnell's membrane, especially posteriorly.
2. The absence of any evidence of active inflammation of the middle ear proper.
3. The severity of the pain in the ear.
4. The slight degree of impairment of the hearing.

In regard to the question of differential diagnosis, there are but two troubles with which the one under discussion

<sup>1</sup> In this connection, we should not forget that, in the two cases just narrated, the local irritation of Schrapnell's membrane—in the one case by the application of a strong solution of nitrate of silver, in the other by the pressure very probably exerted on these parts by the mass of cerumen—may have determined the localization of the inflammation in this particular region. This, I must confess, is a strong point against the view here propounded. On the other hand, if the inflammation had followed directly upon "catching cold," or as a sequela of one of the exanthematous diseases, we might with much greater assurance put forward this view as the correct one.

might be confounded, namely, an acute inflammation of the middle ear proper, and an acute inflammation of the autrum mastoideum and adjoining cells without decided participation of the middle ear proper. In the former affection, the appearance of the membrana tympani tells the story pretty clearly, while in the latter the pain is referred to the mastoid region more particularly, and there is apt to be tenderness on pressure, and, perhaps, even œdema of the skin covering the process.

The diagnosis once established, there can be no hesitation in regard to what is the proper treatment to pursue. An incision through the posterior half of Schrapnell's membrane, close to the insertion of the membrana tympani, is the only thing we can do to relieve the patient's suffering, and prevent (in all probability) subsequent chronic disease of an annoying and even dangerous character.

# A COMPARATIVE SKETCH OF THE EARLY DEVELOPMENT OF THE EAR AND EYE IN THE PIG, TOGETHER WITH A NEW ACCOUNT OF THE DEVELOPMENT OF THE MEATUS EXTERNUS, DRUM, AND EUSTACHIAN TUBE.

By DAVID HUNT, M. D., BOSTON.

UNTIL 1831, when Huschke gave the true account of the development of the inner ear, the ideas of Von Baer misled most of those who investigated the subject. Huschke's account was not generally received, until Reissner, Remak, and Bischoff confirmed it; since then most of the details have been worked up by Böttcher, Middendorp, Hensen, and others, and an excellent *résumé* was given by Kölliker in his "Entwicklungsgeschichte" in 1861. In France and England little of value has been done in this department, and in our own country our best text-books on physiology repeat the errors of fifty years ago.

As to the development of the inner ear, it is now known that an involution of the integument of the embryo forms a sac; by processes to be described this sac forms the cochlea, semicircular canals, vestibule, and accessory parts.

The meatus auditorius externus, drum-head, middle ear, and Eustachian tube, are described as originating from the first branchial cleft which, growing together in its middle portion, forms the drum; the sections of the fissure outside and inside of this point form respectively the meatus externus and

the Eustachian tube. I believe that this view of the development of these parts is incorrect, and shall in this paper state what I believe to be the fact on this point.

Von Baer gave an account of the development of the primary optic vesicle that has held its own against the view of Huschke; in regard to what we now call the secondary vesicle, Von Baer made a mistake that misled many after him; he located the vitreous between the two layers of the retina formed by the folding in of the primary vesicle, or, what amounts to the same thing, in the primary optic vesicle.

In 1830 Huschke described the involution of the lens Remak confirmed his observations, and soon after Vogt and Remak described the manner of growth of the lens fibres from the epithelium of the lens vesicle. Schultze, Müller, Babuchin, Iwanoff, Zernoff, Kessler, Lieberkuhn, and others, have done much in clearing up special points. Prof. Arnold's last contribution, "*Beiträge zur Entwicklungsgeschichte des Auges*," contains one of the most correct and practical accounts that we possess; he follows the process in one species and in an almost complete series of embryos of different ages.

The eye is first formed by a protuberance from the brain, which consists of a hollow stem—the optic nerve—the expanded extremity of which forms a globe, the primary eye vesicle; soon the lens is formed by a thickening and involution of the integument over the vesicle; this process—the involution of the lens—turns the anterior half of the primary vesicle inward; the cavity thus formed is the secondary optic vesicle. The succeeding stages will be described in detail, and a comparison made with the corresponding stage of development of the labyrinth.

*Embryo Pig,  $\frac{3}{8}$  of an Inch long: Ear.*—The otic vesicle is ovoid, the recessus labyrinthi forms a wide-mouthed diverticulum from its upper extremity, the apex of the recessus is surrounded by a thick network of blood-vessels, the commencement of the choroid plexus; at this time the blood-corpuscles vary much in size, and many have a large, round, granular nucleus; sections of the blood-vessels show the nuclei of the cells which formed their walls.

*Eye.*—The eye at this time is a much more complicated



structure: the primary optic vesicle has been doubled in by the inversion of the lens, which at this time is a mere depression of the integument; the cylinder cells in the bottom of this depression are longer than those on its side and on the neighboring surface; the depression itself is filled by a collection of delicate, round, slightly granular cells, which in all probability hold the same relation to the cylindrical cells that the epithelial scales hold to the rete malpighii. I have not been able to find the longitudinally striated layers described by Arnold as covering these round cells; accordingly my sections agree exactly in appearance with Fig. 2, plate xxi., in the 11th vol., 3d part, of the *Archiv für Mikroskopische Anatomie*, where Mihalkovics states that he also is unable to find the layer in question. When the epithelium folds in to form the lens, it carries with it a layer of the connective tissue upon which it rests; this now appears as a hyaline substance in which blood-vessels are rapidly developing; blood-corpuscles are also formed in the layer of tissue bounding the vesicle on the outside. It is interesting to know that blood-corpuscles are seen in this location before a trace of pigment is seen in the retina.

*Embryo Pig,  $\frac{1}{3}\frac{1}{2}$  of an Inch long: Ear.*—The otic vesicle is considerably changed in appearance; it looks now as if compressed from without inward and then flexed, so that it forms a curve with the convexity outward; the apex of this curve is the point at which the horizontal semicircular canal buds out; from the superior extremity there are now two diverticula, one the recessus, and one for the vertical semicircular canals; a slight depression on the inner wall marks the position of the future sacculus rotundus; the epithelium is much thicker at the inferior portion of the sac where the cochlea is budding out and thinnest over the vertical semicircular canal. This form of the labyrinth is evidently intermediate to those illustrated in Figs. 8 and 9, plate 1, by Böttcher, in his "Entwicklung und Bau der Gehörlabyrinth," yet the embryo whose labyrinth I have described was shorter than that from which Fig. 8 was drawn. Although Böttcher used foetal sheep, I think that the difference results from the difficulty, referred

to by Bischoff, of exact measurement of foetal development by means of noting the length.

*Eye.*—The lens is now almost separated from the epidermis; the mouth of the previous depression closes like a purse when the string is drawn; the lens is round; the epithelial wall in its whole circumference consists of cells of like shape, accordingly the cavity in the lens is round; it is filled with cells of the same character as those described as filling the previous depression of the integument which then formed the lens; the inner layer of the retina is four or five times thicker than the outer; the retinal pigment is seen in the anterior portion of the outer layer; it occupies the inner end of the cells constituting this layer of the retina, and not the outer part, as Mauz expressly states in the Graefe-Saemisch "Handbuch." Between the lens and the inner retinal layer the hyaline tissue contains a greater number of blood-vessels; some were carried in with the connective tissue that was pushed in by the lens, some pass through the so-called choroideal fissure. It seems to me that the lens turns in from a position downward and forward.

*Pig Embryo,  $\frac{9}{16}$  of an Inch long: Ear.*—In the embryo  $\frac{3}{8}$  of an inch, we described the recessus labyrinthi as a process leading from the upper part of the sac; in the embryo  $\frac{1}{2}$  of an inch long, the vertical semicircular canals formed another; in the embryo  $\frac{9}{16}$  of an inch long, we can no longer speak of processes, as the whole upper part of the sac is composed of the narrow recessus and the wide cavity of the vertical semicircular canals. Just at the mouth of these canals is a sharp projection outward of the wall of the vesicle; this is the commencement of the horizontal canal. Just below the opening of the recessus on the inner wall is an indentation, the site of the formation of the sacculus rotundus; the lower portion of the vesicle hooks inward under the brain; this hook is the beginning of the spiral of the cochlea; the ganglion of the cochlear nerve is plainly seen; delicate fibres connect it with the epithelium in the cochlear canal.

*Eye.*—The lens has undergone a most interesting metamorphosis; the cells on the posterior wall have now become lens-fibres, which reach forward about two-thirds of the dis-

tance to the anterior wall; naturally the central fibres are the longest; the fibres on the surface are slightly curved, concavity outward; the central fibres are straight; the fibres increase in size from their centre to their anterior extremity, where they present on cross-sections a perfectly amorphous interior and a sharply defined contour; between the termination of the fibres and the anterior surface of the lens is a space filled with protoplasm; it is natural to associate this appearance with the disappearance of the delicate cells that formed the contents of the lens before the fibres commenced their growth, but I know of no direct proof that there is any connection of the two processes. In the vitreous a large number of blood-vessels are seen which ramify upon the surface of the lens; they enter with the optic nerve and through the embryonic fissure; just anterior to the fissure is a cluster of blood-vessels.

*Pig Embryo,  $\frac{11}{16}$  of an Inch long: Ear.*—The semi-circular canals and cochlea have progressed considerably in their development; the indentation for the sacculus is deeper, but the general appearance of these parts is not strikingly different from that in the embryo  $\frac{9}{16}$  of an inch long; the connective tissue surrounding the labyrinth has been transformed into cartilage. In sections of the head at this age, I have seen appearances that would indicate that the cochlear and vestibular branches of the auditory nerve arise from separate roots.

*Eye.*—The lens-fibres have nearly reached the anterior surface; the epithelium of the lens is thinner in front, but increases gradually in thickness to a point about half-way between the equator and posterior pole, where the epithelial cells pass over into lens-fibres; a small triangular cavity exists at the posterior pole; this space is filled with large, round globules that have no structural characteristics; the layer of nerve-cells has commenced forming in the retina; anteriorly, where the posterior layer of the retina passes over into the anterior layer, the character of the cells composing the retina is changed; the body of the cell is here long and narrow; in the other parts of the retina the cells consist of oval nuclei and delicate processes; the pigment is very abundant; the

layer of connective tissue at the site of the cornea has increased in thickness, and the membrana capsulo pupillaris is in the position occupied later by Descemet's membrane; the lids have commenced forming.

*Pig Embryo,  $\frac{7}{8}$  of an Inch long: Ear.*—The cartilaginous labyrinth is clearly defined; the recessus labyrinthi now lies in the connective tissue forming the dura mater, excepting its vestibular end, which lies in cartilage; the dura mater fills out the angle formed by the junction of the temporal and petrous cartilages; in the apex of this angle a sinus has formed; not far from it is seen the extremity of the recessus; the semicircular canals have a hardly perceptible lumen; the cochlea has one and one-half turns; its epithelium is thick and is easily detached from the surface beneath; the greater epithelial protuberance has commenced forming.

*Eye.*—Here a marked change is seen; the sclerotic and cornea can be easily distinguished; the cornea is considerably thicker than the sclerotic, and the corneal corpuscles are seen; they appear to be the developed nuclei of connective-tissue cells, some of which are seen among the corpuscles unchanged; the membrana capsulo pupillaris adheres to the posterior surface of the cornea; the formation of the ciliary body has begun; it is composed of connective tissue from the neighborhood of the corneo-scleral junction, of transformed cells of the retina, and of tissue from the vitreous; its apex is drawn out into a thin hyaline structure that covers the surface of the lens; the lens is solid; in the retina there is an evident stratification; when the two layers of the retina are separated, the limitans goes with the internal layer, and a hyaline substance is discovered that adheres partly to the limitans and partly to the outer layer.

*Meatus Externus, Drum, and Eustachian Tube.*—The idea that the Eustachian tube, tympanum, and external meatus are formed from the first branchial cleft, was first published in the *Isis* by Huschke in 1827. Von Baer did not coincide with this view. In 1828 he described the development of these parts more in accordance with what seems to me to be the truth. Huschke's view as to the development of the otic vesicle was soon proven to be correct, and Von Baer's error on



this point no doubt weakened his authority on the one in question. Von Baer did not follow the development of the ear very closely, as he himself states on page 146, vol. i., of his "Entwicklungsgeschichte der Thiere," so that his descriptions lacked the necessary accuracy. Huschke's statements have been accepted by every writer on development with whom I am acquainted. Kölliker, in his deservedly popular "Entwicklungsgeschichte," gives the history as follows: "The first branchial cleft, which is fully open in the human embryo at the fourth week, closes in the fifth week, not, however, in its whole length, as do the other clefts, but so that at both sides of the place of closure, which lies near the outer opening, the beginning and the inner end of the canal remain open; these parts are nothing other than the sites of the meatus auditorius on the one side and the Eustachian tube and the tympanum on the other."

The history of the development of these parts, as I have found it, is as follows: The Eustachian tube is an involution of the mucous membrane of the pharynx; it is not in any way the remains of a branchial fissure, but lies in the tissue in which the base of the skull is forming; it grows in length as the branchial fissures close. When the cartilaginous cochlea is first formed, the Eustachian tube lies under it, and follows its outline to the site of the middle ear, which at an earlier date is principally indicated by the ganglion of the facial nerve.

The meatus externus is formed as follows: The first branchial cleft in an embryo  $\frac{3}{8}$  of an inch long is very narrow; in its middle portion there is a slight protuberance of the second branchial arch that breaks the otherwise straight course of the fissure. In an embryo  $\frac{5}{8}$  of an inch long, the cleft is closed, excepting that, at the point at which the projection of the second arch was situated, there is a shallow depression remaining; this point corresponds nearly to the middle section of the cleft. The process of closure is interesting: the ends of the inferior maxillary process of the first branchial arch grow together very early—they are joined in an embryo  $\frac{3}{8}$  of an inch long—soon after, the second arch closes in front, and at the same time fuses with the first arch in its ventral portion, so



that the first branchial cleft is obliterated as far as the inner end is concerned; as a result of this process the buccal cavity is closed in. The outer end of the first fissure, seen in profile views of the embryo, has also closed down to the furrow mentioned above, which is situated on the side of the embryo just above the blunt angle formed by the junction of its lateral and ventral surfaces; this depression is a shallow one, and does not represent the whole depth of the fissure; the first and second arches are united beneath it; bisect an embryo  $\frac{5}{8}$  of an inch long in the antero-posterior median plane, separate the walls of the buccal cavity, and the site of the depression is seen to be occluded by a thin, translucent layer of tissue. Now, the projection of the second branchial arch increases in bulk and becomes more pointed, but the thickness of the fold makes the point appear rather blunt at first; the tissue of the first arch on the opposite side of the depression forms a slight ridge. When this point is reached (in an embryo  $\frac{3}{4}$  of an inch long, or little less), the meatus externus commences as a burrow into the tissue of the first branchial arch—or rather into tissue that did compose the arch, for the arch has now disappeared. In an embryo  $\frac{7}{8}$  of an inch long, the meatus is very apparent, the pointed protuberance above spoken of is much thinner, and is now easily recognizable as the auricle; it points forward; the meatus is not only deeper, but, as a proof that the process of its formation is an active process, its termination is much nearer the Eustachian tube. A section of the embryo at this stage shows that the meatus has extended so deeply that its inner extremity lies under the outer portion of the Eustachian tube—in fact, is almost in contact with the tube; the portion of connective tissue lying between meatus and Eustachian tube is the membrana propria of the drum, the meatus forming its dermoid or inferior surface, the Eustachian tube its superior or mucous surface. In the connective tissue above, and posterior to the location of the drum, the ossicles have commenced forming; the stapes does not, as most authors state, form later than the other ossicles, but, no doubt, it appears later in the tympanum. Its first appearance seems to be rather in the vestibule than in the tympanum, not free in its cavity, for it is connected with its cartilaginous walls.

This position of the stapes is caused by a gradual absorption of the cartilaginous wall of the vestibule at this place, caused apparently by the growth of the stapes. I am not aware that this explanation of the formation of the oval window has ever been given; it is, at least, as satisfactory as the ordinary statement, that the "oval window is a portion of the vestibular wall in which ossification did not take place."

According to this view of the development of the parts in question, the concha is the only opening left in the closure of the first branchial fissure, and the furrow bounding the lower border of the under jaw indicates the course and line of closure of the cleft.

I have found it utterly impossible to obtain a satisfactory idea of this part of the history of development, as it has been heretofore presented. In what manner were the dermoid and mucous surface of the drum formed? How did the drum obtain the horizontal position which characterizes it in the embryo? How did the Eustachian tube reach its position at the base of the skull in parts not at all concerned with the branchial fissures? These and many other questions it left unanswered.

The congenital malformations of this part are also but so many puzzles, considered in the light of the ideas that have hitherto prevailed as to its development; for, if those ideas were true (since the most common cause of such malformations is arrest of development), we should expect to find absence of the drum, a meatus or Eustachian tube with fissures in their walls, as the most common congenital defects. Instead of this, occlusion of the meatus is the most common malformation; this, according to the views which we present, is due, as it should be, to the most common cause, viz., arrest of development.

It would be out of place to speak of the phylogenetic relations of the facts here presented, although they are interesting.

To recapitulate: The Eustachian tube is an involution of the pharyngeal mucous membrane; the meatus is an involution of the integument; the drum is formed by the Eustachian tube overlapping the extremity of the meatus.

## PERFORATION OF THE MEMBRANA TYMPANI, WITH SCARCELY A SYMPTOM OF DISEASE.

BY DR. E. L. HOLMES, CHICAGO.

MRS. H., thirty-nine years of age, had enjoyed excellent health till the spring of 1871. In early childhood she suffered from some disease of the left ear, which resulted in a permanent perforation of the membrana tympani without otorrhœa. With this ear the patient has always been able to hear a watch at the distance of two inches.

Quite early in 1871 the patient began to suffer from slight attacks of asthma and bronchitis. Between the spasms there were constant sibilant and musical *râles* in the lungs, changing rapidly in intensity and locality. Late in the summer the patient experienced a very slight itching in the right ear. I was several times consulted for this symptom, but could never detect the slightest appearance of disease. The external meatus and membrana tympani were absolutely free from redness, or any apparent anomaly. Air passed easily into the middle ear; the hearing was normal, as tested by the watch and voice. There was no tinnitus.

At the end of a few weeks the patient suddenly observed, with absolutely no premonitory symptom, that air passed through the membrana tympani. An examination even then revealed no symptom of disease. There was, however, near the periphery of the lower portion of the posterior half of the membrana tympani, a dark-brown deposit no larger than the head of a pin, which was evidently the seat of the perforation. The patient could force air through the opening with

great ease. A couple of days after this, a friend, who had enjoyed an extensive experience in examining and treating diseases of the ear, happened to be present at an examination of the patient. He could detect no objective symptom of disease, except the small deposit, which he considered might be a clot of blood.

It is now five years since the perforation occurred. It has not increased in size, and has not been complicated by any disease, except slight pain a few times on exposure to cold. No treatment has ever been applied.

## REMARKABLE VERTIGO FOLLOWING AN INJURY OF THE MIDDLE EAR, AND PROBABLY THE LABYRINTH.

By DR. E. L. HOLMES, CHICAGO.

MR. T., aged forty-three years, met with the following accident the latter part of August, 1871:

While relieving an irritation in the right ear with the end of a pen-holder, the point was violently forced into the middle ear by changing his position and striking his elbow against a door.

For some minutes the pain was very severe, but gradually subsided in a few hours, although for ten days there were very great dizziness and tinnitus, with total deafness. At the end of three weeks the patient felt well enough to undertake a long journey.

Riding in the cars seemed to cause a return of the vertigo. This became so great that the patient could scarcely walk with safety. For nearly five months this dizziness increased, till the patient was obliged to give up all business.

At this time he came under my care. I found him in excellent general health. The membrana and external meatus showed no symptom of inflammatory action. A small discoloration, which was probably a cicatrix, could be observed just posterior to the centre of the membrana. Air could be easily forced by the patient through the Eustachian tube. The ear was still totally deaf.

The vertigo had increased to a wonderful degree. The slightest motion of the head produced the sensation of falling forward, as if making a complete somersault. So real was



this feeling, that the patient, if he were sitting, was obliged to grasp firmly his chair; if lying flat on his back in bed, he was obliged to seize the sides of the bed and keep his head absolutely quiet. The vertigo was described as a very rapid whirling of the bed forward. At times there was considerable nausea, as also an unpleasant sensation about the head. When the patient held his head with both hands, he could move it with considerable comfort, if the motion was made slowly.

For some time the patient had taken internally pot. iod., pot. bromid., hyd. bichlor., diuretics and cathartics. Blisters and galvanism had been applied over the mastoid. The violent symptoms continued about three weeks, when they began slowly to disappear.

The remedies above mentioned had been so long given previous to the exacerbation of the symptoms, that it is doubtful if they aided in giving relief. I must repeat that, during all this time, there was not an objective symptom in the ear or its appendages.

Mental trouble, confinement, and want of exercise for some months, produced considerable physical prostration, although nutrition seemed quite well supported.

After a few months the patient was able to take a voyage to Europe, where he spent some time without treatment, although the vertigo and tinnitus were slightly troublesome.

Two years and a half after the injury I had an opportunity of examining the ear. There was no objective symptom of disease, and scarcely any tinnitus. On bending the head low, and suddenly raising it, there was slight vertigo.

The general health appeared most excellent. Deafness of the right ear was complete.

# ON GASEOUS INTERCHANGE IN THE TYMPANIC CAVITY; PHYSIOLOGICAL CONSIDERATIONS AND THERAPEUTIC APPLICATIONS.

BY A. LOEWENBERG, M. D., PARIS.

*Physiological Considerations.*—Otology considers it a fundamental fact that, in cases of obstructed Eustachian tube, the air contained in the drum is absorbed to a greater or less extent. Thus are explained the ordinary consequences of occlusion of this canal: sinking inward of drum-head; increased pressure on labyrinthian fluid by the chain of ossicles; diminution of hearing, heaviness, etc. It is needless quoting examples of this assertion; all special treatises and monographs abound in applications of this otological dogma.

The palliative treatment necessarily corresponds to this interpretation of the causes of those symptoms; the "absorbed" air is restored by inflating other air by the catheter, or by Politzer's method, until the middle ear possesses again the normal quantity of air.

To it, long since, this interpretation suggested to me considerable doubt, because it seemed to me to neglect the important question of what really happened in the drum after occlusion of the Eustachian tube. Proofs seemed to me entirely absent for this hypothesis, and I thought them the more desirable, as a prior physical as well as physiological consideration rendered such a phenomenon very improbable. The question, therefore, was, What are the real consequences of obstruction of the Eustachian tube?

Direct experimentation offered the greatest difficulties, not

only because the organ in question occupies a very exiguous space and has only very small dimensions (vivisection), but also for the risk which the object of our special care—the ear—would undergo by such experiments (on men).

I therefore preferred proceeding by means of analogy, that is to say, by examining what happens in other parts of the body easier to be studied, and where, too, exist cavities containing atmospheric air. Here my attention was immediately directed toward the lung, which receives continually large quantities of air, and whose physico-physiological functions we know, besides, extremely well from a great number of remarkable researches, beginning with Lavoisier, Andral, Gavarret, Regnault, and Reiset, and terminating with Ludwig, Pflüger, and their disciples.

In the lung, the same as in the tympanic cavity, air comes in contact with thin membranes abounding in fine capillaries, through which blood flows in a continual stream.

In order to simplify the conditions of this comparison, we shall, for the moment, consider only one inspiration, and take, besides, no account of the compound of gas which the entering air meets with in the lung as well as in the drum.

An inspiration conveys to the lung a certain quantity of air, that is, a compound of azote, oxygen, aqueous vapor, and traces of carbonic acid. What will become of this air? O, Co<sub>2</sub> and Az are soluble in the blood; now, supposing this fluid not to contain any gas, it would simply absorb certain quantities of these gases. According to the laws of absorption of gas by liquids, these quantities depend on the nature of the gas and of the liquid, on the temperature and the pressure. Everybody believes, in fact, that things take place in this way in the tympanic cavity in case of obstructed Eustachian tube, and talks of simple absorption. But, in doing so, no account is taken of several very essential points. In our case, as well as in the lung, air is separated from blood by an animal membrane; blood itself contains, besides O, Az and Co<sub>2</sub>, and pressures are, finally, different on both sides of the partition which separates both liquid and air.

Under these circumstances, there can be no question of a simple absorption, but *diffusion* or *interchange* must take place,

and they are, in fact, as everybody knows, the base of respiration.

This interchange takes place according to the *laws of solubility of gas*, that is:

1. The weight of gas absorbed by the unity of volume of liquid is proportional to the pressure which this gas exercises on it.

2. If a compound of several gases is in contact with a liquid, each of them dissolves itself in the said liquid, the same as if it were alone present, that is to say, according to its pressure and coefficient of absorption.

If blood is the liquid, we must also take into account the chemical affinity between hæmaglobine and O. This affinity plays a very important part in the present case, but even without it O would be absorbed, as all animal tissues produce Co<sub>2</sub>, and consume O.

By applying these principles to the respiratory interchange *in the lungs*, the *following results* are found:

1. As the pressure of O in the blood is insignificant, while it is comparatively enormous in the air, the blood of the capillary vessels necessarily absorbs an immense quantity of O; this action is energetically reënforced by the affinity of hæmaglobine for O.

2. As air contains only an insignificant fraction of Co<sub>2</sub>, while blood, the venous one especially, is very rich in it, blood must cede so much the more of it the less there is contained in air.

(We do not take Az into account, as this gas is as good as indifferent to respiratory interchange.)

This pulmonary interchange gives us an idea of what must happen in the *cavity of the tympanum* in case of obstructed Eustachian tube, as circumstances are very similar in both cases (*see before*). But as to defining accurately the quantities of O and of Co<sub>2</sub> which must remain free, I do not think we are able to maintain entirely the above-mentioned analogy, for the following reasons:

1. In the lungs, air meets principally venous blood; whereas the membrane which lines the tympanum contains, of course, blood of every description.

2. Air comes in direct contact with the delicate cuticle of the pulmonary capillaries, as epithelium, according to the last researches, is as good as absent in the vesicles of the lungs; on the contrary, a layer of epithelium covers the fine membrane which lines the wall of the drum and the organs this cavity incloses.

3. At every moment air is renewed in the lungs by respiration, while in our case the Eustachian tube is shut, and allows no fresh air to pass.

But here, too, physiology comes to our assistance: we are able to avail ourselves, at least for the third point, of the interesting researches of M. Pflüger and Wolffberg (*Pflüger's Archiv*, vol. iv.). Here, too, O disappears, and is compensated only to a certain extent by Co<sub>2</sub>. Putting, therefore, to account the above-mentioned principles, we are justified, I think, in assimilating to these latter circumstances the particular case we are treating of, that is, to put the change taking place in an artificially-shut bronchus in a parallel with the one happening in the tympanic cavity with intercepted Eustachian tube. Here, too, O is absorbed by the blood circulating in the vessels of the drum, and a part of this gas is replaced by Co<sub>2</sub>. *The consequence is, a defect in the remaining total sum of gas*, and this diminution accounts for the sinking inward of drum-head, etc. But we are not able, for the moment, to estimate mathematically the precise amount of each remaining gas, for the sake of the above-mentioned particularities; and, besides, because we do not know to what extent the diminution of volume caused by the gaseous interchange may possibly be compensated by expansion of the air assuming a higher temperature (that of the body), and saturating itself with vapor of water for this higher temperature. These circumstances escape a rigorous analysis, the more as, for instance, all this may, perhaps, take place, more or less completely, during the passage of air through the nose.

*Therapeutic Applications.*—The precedent considerations logically lead me to certain practical applications concerning the treatment of diseases of the middle ear. I tried to prevent, or at least to delay, the diminutions of air in the tym-



panic cavity, caused by this "quasi-respiratory" act (as I shall call it, to be brief), in order to prevent or delay thereby the diminution of hearing caused by this deperdition in case of obstructed Eustachian tube. I therefore substituted for the commonly-used atmospheric air other gas less subject to diminution by "quasi-respiration."

Reflection suggested to me the idea of inflating a gaseous mixture almost natural, as it were, and little subject to diminution by "quasi-respiration," because its composition just equals that of the final result of gaseous interchange, that is to say, it is composed of Az, very little O (if any), and a large quantity of Co<sub>2</sub>, the whole warmed to a degree approaching that of the body, and saturated with vapor of water corresponding to this temperature.

This mixture necessarily must behave quite indifferently toward the gas of the blood; the same as air behaves, according to Pflüger and Wolffberg, when it has undergone the respiratory interchange. And what combination could furnish this compound more exactly and easily than the *lung*?

I therefore employ plainly *expired air* for the inflation. A very deep inspiration, followed by keeping the breath as long as possible, and making a strong expiration, would furnish a compound very similar to the one I wish to obtain; but I found it both more convenient and more sure to complete the gaseous interchange by submitting the same quantity of air to several alternative inspirations and expirations. I make the patient breathe into a bag made of thin rubber, or a bladder, provided with a cock, to which I adapt a piece of rubber tubing; the free end of this latter is introduced into the mouth of the patient, who shuts his nose with the fingers, and inspires and expires alternatively from and into the bag. (Each patient, of course, has his own piece of tubing—a thing I have adopted, a long time ago, for Politzer's method, too, and I even design by a letter the end to be introduced into the nose—for cleanness.) The bag, at the beginning, can be empty or full; in the former case, the patient begins, of course, with an expiration; in the latter, with an inspiration.

The quantity of air, after some seconds, offers the composition of air retained *ad maximum* in the lung (*see* Pflüger and Wolffberg), and I employ it in this very state. I use it in different ways, either by adapting a nozzle to the cock and inflating directly into the catheter, or by Politzer's method by compressing the bag, or by introducing the nozzle of a formerly-compressed common air-bag into the free end of the tubing, opening the cock, and aspirating the gaseous compound, which I inflate several times in each application.

The effect of this method offered to me remarkable advantages: the improvement following inflation of air in appropriate cases was more durable than with common air; several intelligent patients even spontaneously told me that the feeling of agreeable fullness which followed the air-douche was more distinct than otherwise.

So therapeutic experience has confirmed the ideas I have conceived about what takes place in the middle ear.

I have tried also to obtain the same end by another method, founded on the curious properties of hydrogen gas. This substance, as we know by the interesting researches of Regnault and Reiset (*Annales de Chimie*, xxvi., third series), is extraordinarily refractory against respiratory interchange. They found that the lung absorbs next to nothing of it, and that an animal must inspire, during several hours, a compound of O and H to make the latter diminish in an appreciable way. Afterward, M. Grehaut, in a very remarkable paper, *Recherches physiques sur la Respiration de l'Homme* (Paris, 1864), availed himself of this particularity of H for important researches on human respiration. For my part, I have made use of it for my special purpose by substituting H for air in the air-douche, and my results have been similar to those of respired air. Thus these results, too, corroborate my opinion on the nature of the interchange in the tympanic cavity.

I proceed in the following manner: H is prepared after the classic method in a glass bottle pierced with two holes, and containing pure zinc and water, to which I add pure sulphuric acid. H is purified by passing through a bottle con-

taining a solution of caustic potash. I collect the gas in a bag of rather thick India-rubber, or a bladder, ending in a cock, to which I adapt a piece of rubber tubing. When it is to be employed, I introduce into the free end of the tubing the nozzle of an air-bag, previously emptied to the utmost by compression. I open the cock, and the bag fills with H by dilating itself. I then use it as we do with common air, and I fill and empty it several times through the catheter, or by means of Politzer's method. I attend to giving the head of the patient an inclination toward the side opposite the affected ear, in order to put the Eustachian tube in a vertical direction, which favors the entering of H; for thus it mounts not only by the impulsion of the hand, which compresses the bag, but also by its own ascensional power, in consequence of the small specific weight of H.

It is necessary always to use only recently-prepared H, as the endosmotic power of the gas is so considerable that it is impossible to conserve it in a bag or bladder.

It is not useless to advise the danger of approaching a flame in operating with H, for a mixture of H and air would explode with the utmost violence.

All who have had occasion to treat a great number of otological patients will agree with me in considering inflation of air as being at the present day the most invaluable and most generally useful remedy of otology, as well as the most inoffensive. In an immense number of cases we use it to furnish to the middle ear the quantity of air wanted for the functions of drum-head and ossicles, as well as for preserving the labyrinth from excessive pressure caused by sinking inward of this membrane, and thereby of the ossicles. Inflation often restores hearing with wonderful instantaneity, and, for a time, more or less considerably; such are the cases of simple catarrh of the middle ear. It is even the only local remedy of this disease in very young children, as well in acute as in chronic cases.

Inflation being thus of extremely frequent and general use, I hope the modifications which I recommend will prove useful, by prolonging the good effect of each inflation and rendering repetition less frequent, until a more energetic and

more general treatment has mastered the disease itself—a task often very long and difficult.

I therefore recommend to repeat these experiments, in order to ascertain the foundation of my observations concerning the advantages of the above-mentioned methods, and the physiological conclusions their effects implicate with regard to the functions of the middle ear.

## APPLICATION OF PAPER DRESSINGS IN TREATMENT OF PERFORATIONS OF THE MEMBRANA TYMPANI.

By CLARENCE J. BLAKE, M. D., BOSTON.

FORMING, as it does, the boundary between the outer and the middle ear, its outer surface covered by a continuation of the dermoid lining of the external auditory canal, and exposed to the outer air, its inner coat a continuation of the mucous lining of the tympanic cavity, the membrana tympani is liable to participation in the diseases which may affect either of the cavities which it separates, and is also liable to mechanical injury from forces acting from without through the external auditory canal.

Von Tröltsch says: "Three of the most important tissues of the animal system are found in this membrane: integument, mucous membrane, and fibrous tissue; hence pathological changes are very common in this part. Although affections of the membrana tympani are very frequent, exact and unprejudiced observation must show that they seldom occur alone, and uncomplicated with an affection of another part of the ear. The membrana tympani is nourished by the same blood-vessels and nerves that supply the cavity of the tympanum and the auditory canal. It thus really only forms a part of these divisions of the ear. In any affection of the adjacent parts, therefore, the drum-membrane will almost always be involved."

Injuries of the membrana tympani also, says the same author, are quite common, as we would infer from the delicacy



of structure of the membrane and its exposed position.<sup>1</sup> The most frequent of the more serious lesions of the membrana tympani, as may be inferred from its structure and anatomical relations, is perforation. The most frequent cause of perforation, says Politzer, is purulent catarrh of the middle ear.

Perforation as the result of violence may be caused by concussion of the air, the atmospheric pressure causing a sudden excursion of such amplitude as to exceed the natural extensibility of the membrane and rupture it across its whole surface. Several cases of this form of injury are reported by Dr. J. Orne Green, the concussion resulting from the explosion of the gas apparatus of a stereopticon. During the late war, also, such cases were not infrequent among artillerymen in the army, and in sailors on vessels carrying heavy guns in the navy. They occurred generally, however, either where men were peculiarly exposed, or where some affection of the middle ear, such as closure of the Eustachian tube, resulted in a preponderance of atmospheric pressure on the outer surface of the membrane.

Perforations of this sort, as would be expected from the nature of the force which causes them, and the structure of the fibrous coat of the membrana tympani, are usually rents with ragged edges, which readily fall into apposition, and which, provided the injury to the middle ear is not sufficient to set up extended inflammation and consequent discharge, as readily heal. The reconstructive power of the membrana tympani is proverbially great, and it is not uncommon to find such rents, under favorable circumstances, entirely closed within forty-eight hours. Similar ruptures may be caused by atmospheric pressure from within. Mr. Hewetson<sup>2</sup> has reported a case of rupture of the right membrana tympani as the result of a severe attack of vomiting; and it has been my own misfortune to cause a rupture, extending from the upper to the lower border of the membrane, across the posterior segment and parallel to the handle of the malleus, by the use of Politzer's

<sup>1</sup> "Treatise on Diseases of the Ear." Von Tröltzsch. Translated and edited by D. B. St. John Roosa, M. D. W. Wood & Co., New York, 1869.

<sup>2</sup> London *Lancet*, September, 1875. "Rupture of the Right Membrana Tympani from a Severe Attack of Vomiting."

air-douche. Mr. Hewetson's treatment consisted in warm syringing, and the use of alkaline and then astringent instillations, the opening healing perfectly in eight days. It had become partially healed in the interval between the occurrence of the accident and the patient's application for treatment, and the removal of a crust revealed an opening which healed as above stated. In the other case, the ear was simply protected by cotton, the patient being warned not to blow his nose for two days—which injunction he would seem to have punctually obeyed, for, on his return at the end of three days, the rupture had entirely healed. The rules for the treatment of these fresh ruptures would be the same which apply to the treatment of a rent elsewhere: to cleanse the edges from any coagula or foreign matters, and to bring them into apposition and keep them so.

The cleansing may be effected by a little jeweler's cotton on the end of a probe dipped in warm water; and, unless blood has flowed into the middle ear, care should be taken to prevent the entrance of fluid into that cavity. Where the edges of the rent do not fall readily into contact, the contact may be effected by alternately inflating the middle ear and pressing upon the membrane with the probe. The edges of the rent once in place, the patient should be cautioned against inflating the ear for at least forty-eight hours; and, for further protection, the external auditory canal may be stopped with cotton-wool, or, if the edges show a tendency to separate, their continued contact may be further insured by the application of a bit of paper as described further on.

Perforations, the result of mechanical injury, vary greatly in extent, in the shape of the opening, and in their position in the membrane. The posterior half of the membrane is the most frequent seat of these lesions, because the attacking force usually comes from in front; and the size and shape of the opening depend on the character of the instrument, the force of the blow, and the degree of resistance offered by the membrane. Wounds of this sort heal less readily than simple ruptures; the injury to the deeper-seated parts is likely to be greater; the destruction of the substance of the membrane is apt to be more extensive, and the edges of the opening are

usually pushed inward and more widely separated. If the foreign body which caused the injury remains in the membrane, it should be carefully removed, the edges of the opening drawn outward by a small hook or bent probe, or forced outward by inflation of the middle ear, cleansed and brought into apposition, and the ear protected as before. Occasional inflation may help to keep the parts in contact; but if by the third or fourth day the opening has not closed, and there are no signs of trouble in the middle ear, the paper dressing may be applied, usually with advantage.

Perforations of the membrana tympani occurring as a complication of disease of the middle ear are of a very different character from those already mentioned. They usually follow an inflammatory process of such duration, that the membrana tympani has itself become implicated, and its tissues have undergone such changes as to render it unable to resist either a sudden pressure from the fluid in the middle ear, or the slower but no less fatal invasion of an ulcerative process. In purulent catarrhal inflammation of the middle ear, which is by far the most frequent cause of perforation, the stages which lead to this result follow each other in an almost invariable order. The inflammation of the mucous membrane lining the tympanic cavity and the Eustachian canal soon closes the latter passage at its narrowest point, and cuts off the natural provision for escape of the fluid which soon begins to fill the middle ear. This mucous or muco-purulent fluid, gradually accumulating, presses the already inflamed membrana tympani outward, subjecting it to a force which still further diminishes its power of resistance by inducing changes in its tissues. Every severe inflammation of the mucous membrane of the middle ear, affecting also the mucous layer of the membrana tympani, produces a softening such as occurs in inflammation of other tissues; this may occur throughout almost the whole of the mucous layer, or may be confined to the point subjected to the greatest degree of pressure. The final cause of the perforation may then be either an infiltration of the tissues of the membrana tympani, the opening at first being minute and then rapidly enlarging, or a suddenly-added pressure such as may be caused

by coughing, sneezing, or blowing the nose, which bursts the already-overburdened membrane, and produces a copious discharge. The openings which occur in this manner approach a circular form, and vary greatly in size and position, according to the severity of the inflammation, the degree of pressure, and the length of time during which the membrana tympani has been exposed to its effects, and the condition of the membrane previous to the attack. So far as the treatment of these perforations is concerned alone, this can only follow the treatment of the original disease ; so long as there is sufficient discharge to require a vent into the external auditory canal, the opening will probably remain to fulfill that office. In the majority of cases it would be to the patient's benefit if the opening became closed so soon as it was no longer required for this purpose ; but while, as is well known, it is extremely difficult to maintain an artificial opening in the membrana tympani, it is almost as difficult to induce the closure of one which has followed an ulcerative process in the middle ear. The advisability of attempting to favor the closure of such a perforation must depend upon the degree of benefit to the hearing, which itself depends upon the perceptive power remaining to the internal ear and the sound-transmitting power remaining to the structures of the tympanum. If the disease has extended to the labyrinth, there is little justification in making any such attempt, for in time the mucous membrane of the middle ear exposed to the air undergoes such changes as to render it but little liable to injury from the exposure. In many cases where the inner ear is intact, the changes in the membrana tympani and middle ear are of a character to destroy or greatly diminish the vibratile or sound-transmitting power of the membrane and ossicular chain as a whole ; but the sound-waves, gaining admission to the tympanic cavity through the perforation, reach the labyrinth with more or less diminished force. Where, however, the ossicula have been left free to transmit sonorous vibrations, and enough of the surface of the membrana tympani remains to receive and vibrate in response to the impact of the sound-waves, the closure of the perforation will usually considerably improve the hearing. When the opening is a sizable one, more than two millime-



tres in diameter, for instance, it is usually necessary that the cicatrix should approach in degree of permanent tension the tension of the membrana tympani itself, otherwise there would be an irregular surface whose varying degree of tension would be accompanied by varying degrees of hearing power. In the natural process of repair the opening becomes closed by a membranous cicatrix, the growth of which occurs from the edges of the perforation, not extending toward the centre as a whole, and so uniting, apparently, but by successive growths from different portions of the edge, so that in the process of closure the opening is continually changing its outline.

Where the disease in the middle ear has subsided and the discharge has ceased, leaving a perforation of the membrana tympani with cicatrized edges, the closure of which would improve the hearing, it is necessary to produce such a degree of irritation as shall stimulate a new growth in order to favor the desired result. Cauterization of the cicatrized edge by various means has been recommended, but according to Gruber this treatment is of no value. That author recommends and practises scarification of the part, and also incisions in the vicinity of the opening. Whatever means may be employed to excite a new growth, the reparative process once started should be allowed to proceed with as little interference as possible. Varying atmospheric pressure, on the outer or inner surface of the cicatrix forming, will tend to extend it irregularly and prevent the attainment of the desired tension. To protect the new growth from disturbances will be to secure the fullest effect of the natural process of repair. In these cases I have found a very simple procedure to be of material assistance, either where scarification has been resorted to to produce the necessary degree of irritation, and to clear away the cicatrix binding the edges of the opening, or where the irritation produced by the application to be described proves to be, as is often the case, sufficient. This procedure consists simply in the application of a disk of paper a little larger than the perforation to be covered. Common writing-paper best answers the purpose, for these reasons: it is easily procured of any desired thickness, and the sizing, usually em-



ployed in finishing the paper, when moistened, is sufficiently viscous to insure the adherence of the paper to the membrana tympani. A disk of this sort may be readily introduced under good illumination by means of a pair of forceps, or, better still, by means of a probe tipped with cotton and dipped in water, the paper adhering to the moistened cotton until it comes in contact with the membrana tympani. Any improvement in hearing which may subsequently result from the cicatricial closure of the perforation is at once appreciable on the application of the paper, which should be firmly pressed into place by a probe tipped with dry cotton. Experience proves that a bit of paper thus applied will remain in position until the opening, if a small one, has become closed, when it will be removed by a natural process, or until some inflammatory process recurring causes sufficient discharge to wash it away; in the latter case, when the inflammation has subsided and the surfaces are again dry and clean, the paper may be reapplied. The paper dressing is serviceable only in a limited proportion of cases, namely, those in which the perforation is a small one, the inflammatory process in the middle ear having subsided and discharge having ceased, and the outer surface of the membrana tympani having returned to its normal condition, or in cases of rupture or mechanical injury where the paper may serve to keep the edges of the wound in apposition.

The advantages of this treatment, which is applicable only to certain cases, as above mentioned, are: that it temporarily supplies the place of the natural closure of the opening in the membrana tympani, immediately improving the hearing in cases in which this result would follow a cicatricial growth; that it is in some cases sufficient in itself to cause the irritation necessary to the promotion of a new growth of tissue; and that in any case it protects the new growth beneath it and assures the undisturbed completion of the process of repair.

One of the more favorable instances of the value of the paper dressing, which may be cited in illustration of its use, was that of a woman twenty-eight years of age, who had a perforation of the right membrana tympani,  $1\frac{1}{2}$  millimetre in diameter, in the anterior inferior segment, the result of a purulent inflammation of the middle ear; the inflammation had subsided and

the discharge ceased six months previously; the tympanic cavity was dry, its mucous membrane healthy, and the membrana tympani but slightly opaque; there were no congested vessels or other signs of a progressing reparative process visible; the hearing for the watch was  $\frac{5}{180}$ . On the 24th of August, 1875, a disk of thin writing-paper, about  $2\frac{1}{2}$  millimetres in diameter, was applied, covering the perforation, and the patient directed not to inflate the middle ear for forty-eight hours; the hearing for the watch increased on application of the paper to  $\frac{30}{180}$ . When next seen on the 18th of October, the hearing for the watch had further increased to  $\frac{35}{180}$ ; an examination of the ear showed the perforation to have become closed by a tense, firm cicatrix, and the piece of paper was discovered on the posterior wall of the auditory canal about half an inch from the meatus, with a thin membrane, formerly a portion of the dermoid coat of the membrana tympani, firmly adhering to it.

The displacement of the paper disks after the closure of the perforation in the cases which have furnished the material for this paper led to a series of observations on the growth of the dermoid coat of the membrana tympani, the results of which will be published later.

## A CASE OF ABSCESS OVER THE MASTOID REGION, EXTENDING TO THE SQUAMOUS PORTION, AND INVOLVING THE BRAIN WITHOUT HARM TO THE AUDITORY APPARATUS.

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ALEXANDER WHITTON, aged two months, was suddenly found to have an abscess over the inferior portion of the mastoid region. He was a foundling in the New York Foundling Asylum, and consequently under the care of competent nurses, who were ready to detect the first signs of any external disease. The abscess was freely laid open within a few hours after its discovery, and about two drachms of a creamy, natural-looking pus was evacuated.

At this time there was a slight discharge from the meatus, but, beyond a moderate maceration of the lining of the canal and dermal layer of the membrana, no lesion was visible. This discharge continued only three days, and did not return. The abscess discharged pus constantly until death, a period of three weeks.

There were no head symptoms until forty-eight hours before death. These symptoms were as follows: general sluggishness; pupils about normal in size, but not responsive to light; divergent strabismus in both eyes; died comatose. There was little or no rolling of the head; no opisthotonos; very little febrile movement; bowels natural; no vomiting. The last twenty-four hours he failed to nurse altogether.

Autopsy twenty-four hours after death, at which I was assisted by Dr. Edwin Hutchinson, of Utica, N. Y. The external abscess was located in the lower portion of the mastoid region; about three-fourths of an inch above and slightly behind the meatus was an opening in the squamous portion of the temporal bone about one-third of an inch in diameter. At this orifice, the jagged edge of a small and scale-like sequestrum was observed, which was very movable. On opening the calvarium, about two ounces of fetid, greenish-yellow pus was found in the anterior fossa of the skull, bathing the anterior lobes of the cerebrum, partially filling the lateral third and fourth ventricles, and bathing the medulla oblongata and inferior portion of the cerebellum as far as the foramen magnum. The ventricles were partially lined with a lymphoid-looking material, which was dotted by numerous and minute blood extravasations.

The optic chiasma and anterior portions of the anterior lobes of the brain were covered with lymph, and softened. There were at the anterior and inner portion of the middle fossa a sudden swelling and lifting up of the meninges of about half an inch in diameter, the apex of which presented an aperture communicating with a minute abscess. By pressure, a few drops of very thick, creamy pus were squeezed out.

From the necrosed opening in the squamous portion the meninges were lifted up to such an extent as to cause a communication with the little abscess already mentioned, and presented a surface of detached meninges measuring an inch and three-fourths by three-fourths of an inch in diameter. The tympanum and labyrinth were sawn across, and no disease of any sort was found of the auditory apparatus, except the slight dulling of the dermoid layer of the membrana, before alluded to.

I confess that, during life, I was only able to diagnosticate a mastoid periostitis with abscess.

A child of this age (two months) has few or no mastoid cells, except, perhaps, an antrum, and cell disease is wellnigh impossible.

I infer that the periostitis extended itself to the necrosed

spot in the squamous portion, although during life I saw no evidence of its presence. In the region of the necrosed point, the skull of a child of this age is very thin, not perfectly ossified, and incapable of resisting these destructive processes. This case is reported because it is the only one of the kind I have ever met with, nor have I read of a similar one.



## SYPHILIS OF THE COCHLEA (COCHLITIS?).

By D. B. ST. JOHN ROOSA, M. D., NEW YORK.

SOME three years and a half since, in writing upon diseases of the labyrinth, I stated that I had yet to see a case of recovery from syphilitic disease of that part of the ear.<sup>1</sup> Since that time I have reported one case of cure of syphilis of the cochlea by the use of mercury and potash.<sup>2</sup> I have also very lately seen a similar case in which very great improvement has resulted from an anti-syphilitic treatment; so great a one, that we may hope for much more, since the case has been under treatment but a month. These cases have, of course, made me more hopeful as to the prognosis of syphilitic disease of the labyrinth. They, with some others, that I will now report, have also assisted me to a clearer idea of the symptoms and nature of the disease, although much remains that is unpleasantly obscure, especially as to the pathology. This much is certain, however: The clinical investigation of recent cases will aid us very much in determining just how to distinguish diseases of the labyrinth from those of the middle ear, and perhaps to go a step farther, and locate them in the vestibule, semicircular canals, or cochlea. I beg, therefore, to again report the outline of the first case alluded to, with the additional ones. Before doing so, the symptoms that may be somewhat relied upon in making a diagnosis of disease of the cochlea, and of the other parts of the labyrinth, will be tabulated:

<sup>1</sup> "Treatise on Diseases of the Ear," p. 564.

<sup>2</sup> "Archives of Dermatology," vol. i., part 3.

1. Disease of the cochlea, as of the other parts of the labyrinth, usually, although not always, manifests itself suddenly. The patient can definitely fix upon a time when he became deaf, and when he began to have tinnitus aurium. This is true even when one side only is affected. The one-sided deafness would not be so quickly recognized were it not usually accompanied by tinnitus, vertigo, and often by unsteadiness of gait. Sudden loss of hearing, and the sudden occurrence of tinnitus, vertigo, and staggering, are not, however, entirely peculiar to labyrinth-disease, since it is well known that we sometimes, although rarely, have the same symptoms in cases of inspissated cerumen and catarrh of the middle ear. They are therefore only of pathognomonic value in connection with the objective examination and tests.

2. The tuning-fork is usually heard better, or only, in the sound or better ear. This would be a much more valuable test, were the average powers of exact and objective observation better than we find them among our patients. The value of the tuning-fork is impaired by the willingness of even intelligent patients to believe that they hear all kinds of sounds, no matter how produced, better with the better ear. Then, again, if both ears be affected to nearly the same degree the test has an extremely limited value.

3. The examination of the membrana tympani, and the employment of the methods for inflating the middle ear, will usually give us reasonable conclusions as to the situation of a given disease of the ear, so that, at the least, we may exclude collections of fluid in the tympanic cavity in making a differential diagnosis between disease of the middle ear and of the labyrinth.

4. The piano, or any very similar musical instrument, will aid us in determining whether or not disease of the cochlea exists. The examination of cases that were unquestionably affections of the labyrinth shows that the power of appreciating low tones is the last to suffer, and the first to recover, in most cases of disease of this part of the ear, so that these will be heard when the high ones are not heard at all, or, if they are appreciated, they appear "*false*" or doubled. From our present knowledge of the physiology of hearing,

when these symptoms are present, we must conclude that the cochlea is the seat of disease, even if it be secondarily affected.

5. The diagnosis of *syphilis* of the labyrinth depends in a great measure upon the same kind of evidence as that from which we conclude that a case of optic neuritis or choroiditis is syphilitic; that is to say, the history, and the presence of other symptoms, as eruption, mucous patches, etc. It should not be forgotten, however, that the occurrence of labyrinth-disease, in a person who has probably had the initial lesion of syphilis, even if no other symptoms are present, is a very suspicious circumstance, which should lead to a careful weighing of the indications for and against a mercurial treatment.

I prefer to say disease of the cochlea, instead of disease of the labyrinth, when the prominent symptoms, as in the cases now reported, are great impairment of hearing, the inability to hear certain tones, and the production of false ones. These are evidences, I think, of cochlear disease, whatever else we may have. Tinnitus is a symptom common to many forms of aural affections, while vertigo and unsteadiness of gait are chiefly to be referred to undue pressure from the base of the stapes upon the semicircular canals, and not to disease of the cochlea. I think too much stress has been laid upon increased pressure upon this latter-named part of the ear, to the neglect of disease having its origin in the tone-perceiving apparatus—the cochlea. “Ménière’s disease” has always seemed to me an unfortunate name, since it has been indiscriminately applied. It ought not to be used unless it refers to a case such as that in which a hæmorrhage into the semicircular canals was found. Of late, cases in which the cochlear symptoms are, at least, the predominant ones, are sometimes styled cases of “Ménière’s disease,” when they have very little in common with cases of hæmorrhage. In short, I think we should, in making a diagnosis, begin to localize the part of the ear that is chiefly affected. It is interesting to notice that we are always assisted in a diagnosis of supposed cochlear disease, if the patient have a musical education. I believe all the cases of double hearing that have been reported occurred in musicians. Certainly other patients have had the same symptoms, but they have been unable to appreciate

them. The power of hearing certain tones can, however, be accurately tested in all patients except young children.

CASE I.—Wm. M., aged thirty-seven. The patient states that, five weeks ago, on one particular day, he observed that his hearing was impaired, and that he had a noise in his ears. From that time to this he has grown worse. He also states that his hearing is worse at night. About six months ago he had a chancre, three months later he had alopecia, and there is now a copper-colored papular eruption upon his wrists and arms.

Hearing distance: R.  $\frac{0}{40}$ , L.  $\frac{\text{Laid}}{40}$ .

The tuning-fork is heard better in the *left* ear. The pharynx is granular and in a hypersecretive condition. The drum-heads both show small light spots. The usual treatment for catarrh of the middle ears has been employed since the attack of tinnitus and the loss of hearing, but without success.

The patient was immediately placed upon anti-syphilitic treatment, which he carried out with but moderate faithfulness, but he began at once to improve. Two months after, his tinnitus was relieved, and the hearing distance was: R.  $\frac{\text{Pressed}}{40}$ , L.  $\frac{6}{40}$ . After this he went under the care of Dr. Sturgis for other symptoms of syphilis, and he informed me that he heard very well.

CASE II.—Mrs. X., aged thirty-one, April 8, 1875. Seven weeks ago this patient, who was brought to me by her husband, a physician, began to observe an impairment of hearing, accompanied by a dull pain and by tinnitus.

Hearing distance: R.  $\frac{10}{40}$ , L.  $\frac{4}{40}$ .

The husband, and the note of a physician who had supervised the treatment of the patient, state that she had not been well since the birth of her child in August last, when an abrasion (syphilitic) was found on the os uteri. This the husband says was probably produced by infection from his own finger, upon which was the initial lesion of syphilis, contracted in attending a case of labor in a syphilitic patient.

The symptoms from which Mrs. X. suffered before the loss of hearing were neuralgic pains about the eyes, hyperæmia of the optic disks, papular eruption on the chest, and alopecia. There are now traces of the eruption, and the patient has a

poor appetite, pains in her legs, and some neuralgia about the eyes. The treatment was anti-syphilitic in the beginning, but has not been very thoroughly carried out of late. The pharynx is granular, and the left drum has no light spot. The usual treatment for catarrh of the middle ears has been pursued to some extent, but with no benefit, for the aural symptoms are increasing.

A thorough anti-syphilitic treatment was undertaken, and, according to a note from the husband, and a verbal communication from the physician who first observed the case, the patient progressed steadily to recovery under this management. I have not seen her since she first consulted me.

CASE III.—Mr. U., aged thirty-three, August 30, 1876. The patient states that toward the end of last June he observed dullness of hearing and tinnitus in both ears. Soon after he discovered that he was totally deaf as to the left ear, and the right ear has been growing gradually worse.

On August 1st he began to have attacks of vertigo and staggering, and has had several since. He had a venereal sore on the penis about February 15th, and says he had mucous patches in his mouth and throat about the middle of March.

Hearing distance: R.  $\frac{0}{40}$ , L.  $\frac{0}{40}$ .

He hears words when spoken distinctly *into* the right ear. The drum-heads are both dull in color and have no light spots. The air enters both tympanic cavities freely upon the employment of Politzer's method, and reddens the drum-heads, but causes no improvement in hearing.

A diagnosis of syphilitic disease of the labyrinth on both sides was made by my associate, Dr. E. T. Ely, who saw him first; and after the patient had seen Dr. E. L. Keyes in consultation, he was put upon a course of inunction, with the oleate of mercury, mercurial baths, and iodide of potassium internally in steadily increasing doses.

On September 9th he was already better. He could hear the voice much better; the attacks of vertigo continued, but there was no more staggering.

A more complete examination showed some peculiar symptoms, which throw some light upon disease of the cochlea, and



which are therefore now detailed. The noises of the street *jar* the patient's head very unpleasantly. He cannot distinguish sibilants; *s* sounds like *f*, etc. The notes of the piano become discordant at fifth C. They do not sound *double*, but *false*. In the higher notes, the seventh note sounds more like the octave than the octave itself.

*September 12th.*—There is a little more improvement in the hearing. He hears notes truly about an octave higher than on the 9th. When an upper note is struck, he also hears with this the half-note above. He still complains of the unpleasant effect of the noisy streets. The drugs have been steadily continued, and with no unpleasant effects. He is allowed to leave New York and go to the sea-side.

*September 19th.*—The patient now hears conversation with the right ear at ten feet. The left ear seems to have no power whatever. The dose of potash has now reached seventy-five grains three times a day.

*October 5th.*—Hears the voice at twenty feet with ease. All but the last two notes of the piano are heard correctly. *S* still sounds like *f*. Is taking 120 grains potash three times a day. The history rests here for the present.

It is possible that we have not paid enough attention to the protection of inflamed or hyperæmic ears. As has been shown,<sup>1</sup> boiler-makers may protect their ears from the destructive hyperæmia, caused by the concussions to which their work exposes them, by plugging the meatus; and telegraph-operators may suffer from an impairment of hearing induced by exposure to the continuous clicking of a telegraph-instrument. In the case just reported, the patient experienced great relief from the change of residence from near the noisy pavements of New York to the quiet of the sea-side; and I believe, when noise produces such a degree of irritation as was complained of in this case, we should carefully select a residence for the patient with a view to keeping him out of noise. In ophthalmic therapeutics a great deal of care is often necessary to protect the eyes from the light, and in acute aural disease, and perhaps in some forms

<sup>1</sup> *American Journal of the Medical Sciences*, vol. lxxviii., p. 377.

of chronic affections, the same care should be exercised, lest the ears be exposed to loud or continuous sounds.

CASE IV. is one that I saw at the Manhattan Eye and Ear Hospital, through Dr. E. T. Ely, who had charge of the patient at the Eastern Dispensary, and who diagnosticated disease of the labyrinth. Mr. L., aged twenty-two, September 7, 1876. Complains that two days ago he was suddenly attacked by complete deafness in left ear, accompanied by noises like "the blowing off of steam." These symptoms have continued, and he has also had slight vertigo and feeling of unsteadiness—most troublesome when he turns his face upward. He had a venereal sore on penis two years ago, and subsequently sore mouth, falling of his hair, and iritis. Was treated for syphilis by reputable physicians.

Hearing distance: R.  $\frac{40}{0}$ , L.  $\frac{0}{40}$ . Tuning-fork heard only on right side. Drum-heads somewhat sunken, with dull color and dull-light spot. Air enters middle ears readily through Eustachian tubes, but does not improve hearing.

*September 20th.*—Patient has been treated for catarrh of the middle ears, without any benefit. Anti-syphilitic treatment was advised at his first visit, but he has refused it thus far.

The diagnosis in this case has not been subjected to the crucial test of treatment. Its syphilitic character cannot, therefore, be so strongly emphasized. Yet, when a history of general syphilis is so distinct, and a labyrinth-affection occurs, I think we may safely conclude that the latter is at least *modified* by the venereal poison, if not actually caused by it.

It is undoubtedly true that affections occur in syphilitic patients (from suppression of the perspiration, for example) which would have occurred all the same had they not been syphilitic; and yet, the exposure or imprudence having once caused the attack of inflammation, it immediately assumes the character of a syphilitic affection, by reason of the syphilitic blood, whose increased flow to the part, and the exudation, go to constitute the inflammation. The complete failure of the anti-catarrhal treatment, although all these patients showed some catarrhal symptoms, was another striking evidence of the real nature of the cases, for we seldom meet with cases of

catarrh that do not respond to some extent to the use of the catheter, Politzer's method, etc. ; while in acute or sub-acute labyrinth-diseases this treatment often aggravates the symptoms.

We do not know as yet what part of the cochlea corresponds to the low and what part to the high notes of a musical instrument ; but we do know, as has been intimated in a preceding part of this article, from what has been seen of diseases of the labyrinth, not only in such cases as those just given, but in those resulting from cerebro-spinal meningitis, that the parts tuned for low tones suffer less than the others. The former will remain unhurt, or at least with a certain power of perceiving sound, when the latter have no power at all. I have now a patient under observation, however, who seems to have labyrinth-disease, secondary to a catarrhal affection of the middle ears, who presents some symptoms that seem to contradict this view. With the right ear (the one in which I think the nerve is diseased) he can hear the high notes of a piano better than the low ones. In walking on the sea-shore he hears the crickets in the grass, but not the roar of the waves ; he can hear the chirping of insects and the movements of their bodies easily ; the tick of a watch is heard normally,  $\frac{40}{40}$ , and yet he cannot hear the tones of the human voice at all well. With the left ear, whose hearing distance for the watch is but  $\frac{1}{40}$ , the power of hearing conversation is so good that the patient, a young man of seventeen, carries on his studies at college with no particular difficulty.

These clinical facts may yet be fully explained by the physicist working with musical instruments, at least as soon as the pathologist has determined the exact nature of the diseases of the cochlea.

## HYPEROSTOSIS OF THE MASTOID.

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THE inflammations of the mastoid, to which so much attention has been given of late years, have been proved to consist not of one single but of various pathological conditions, according as the mucous membrane lining the cells, the bone itself, or the external periosteum bears the brunt of the inflammation, all of the different varieties, however, arising from and caused by a primary inflammation of the mucous membrane of the tympanum, which extends back into the mastoid cells, and serves as a periosteum to the internal or tympanic surface of the temporal bone. In fact, both the tympanic and mastoid inflammations are essentially a periostitis in the interior of the temporal bone.

As the result of this periostitis in the interior of the mastoid cells, we may have any one of these conditions: 1. The inflamed membrane may secrete pus, and fill the cells, producing the so-called abscess within the mastoid; 2. The inflammation may extend from the cells along the minute vessels and periosteal projections, which penetrate the bone through its innumerable foramina, and thus set up a periostitis on the external surface of the mastoid; or, 3. An inflammation of the bone itself (an osteitis) may be caused.

This osteitis may be either purulent or hyperplastic. When purulent, we may have, as the result of the inflammation and the accompanying exudation in the tissues of the bone, absorption of the whole bone, as is seen in those cases of mastoid disease in which the bone is perforated by the inflammation;

or we may have absorption only of the calcareous particles, leaving the bone atrophied and soft, as is seen in cases in which the bone can be readily incised with the knife; or, finally, we may have suppuration, with the death and separation of certain circumscribed portions of the bone (necrosis), or a gradual destruction of the bone (caries). When hyperplastic, we have a new formation of bone from the periosteum, external and internal, and from the medullary spaces of the bony tissue, causing a hyperostosis which increases the thickness of the bone to many times its normal proportion, or in extreme cases obliterates the entire mastoid cavity.

Several of these conditions may, of course, exist in the same subject at the same time. The pure forms of periostitis, external and internal, and the purulent forms of otitis constitute the majority of mastoid inflammations, as seen or at least recognized in practice; but, with extension of the operation of opening the mastoid cells, and a better knowledge of the indications for its performance, the hyperplastic variety will, I think, be found more common than is now generally supposed.

As yet, too few cases have been reported for us to be able to decide either on the diagnosis or on the treatment of this variety, but, with the hope of contributing something to its history, I report the following cases:

1. *Chronic Purulent Inflammation of the Tympanum; Hyperostosis of the Mastoid; Trephining of the Mastoid; Apparent Recovery; Death Five Months after, probably from Abscess of the Brain.*—D. H., aged twenty, entered the City Hospital May 31, 1875, and came under the care of Dr. Edes, with the following history: He had had a continuous otorrhœa on the left side from childhood, and for this had consulted an expert in ear-diseases, who found a purulent inflammation of the tympanum with perforation of the membrana tympani, through which granulations protruded. These had been cauterized a few times, and he had been directed to keep the ear clean by syringing with warm water, but had not applied for further treatment for more than a week before entering the City Hospital. A few days before entrance he began to complain of headache and pain behind the affected ear,



with dizziness, and at the same time the discharge from the ear, which had been profuse, ceased entirely. At the time of his entrance to the hospital, record gives the following condition: "Seems to be of feeble understanding; complains of headache, especially behind the left ear, and general weakness; is unable to stand on account of dizziness; often makes ineffectual attempts to speak; often cannot fix upon or pronounce the word he wants; says he knows the word he wants to use but cannot pronounce it; tongue thickly coated in centre; pulse 72 and regular; temperature 101.2°; no appetite; marked thirst; bowels moved this morning; mouth drawn slightly to the left side; tongue protruded straight; left eye injected, and left pupil slightly more dilated than the right; headache increases at night; does not sleep well." He was ordered a mixture of bromide of potassium and chloral hydrate.

*June 1st.*—A. M. All the symptoms were worse; the paralysis of the right side of the face, the opposite side from the ear-disease, had increased; the pain was worse; the stupor was more marked, and when roused he was unable to speak intelligibly, although he seemed to understand questions. Pulse, as before, 72.

At 2 P. M. I saw him in consultation with Dr. Edes. The facial paralysis on the right side was more marked than in the morning; the tongue for the first time was protruded toward the right side; his speech was utterly unintelligible; stupor extreme; pulse, 72. On examination of the ear, I found no swelling or œdema externally over the mastoid; meatus slightly congested in its deeper parts; membrana tympani swollen and red, with a perforation on the anterior lower segment of the size of a pin's head, through which thick purulent matter exuded. The mastoid and the parts just below the auricle between the mastoid and jaw were tender on pressure, and there was slight swelling behind the angle of the jaw.

It was decided to perforate the mastoid, and, under ether, the bone was exposed just behind the auricle; the mastoid cells opened by means of a trephine one-fourth of an inch in diameter; the bone removed was very dense, and seven-six-

teenths of an inch in thickness; there was no pus or other deposit in the mastoid cells; warm water was syringed into the opening and returned through the meatus, and the whole tympanum was drenched in this manner thoroughly every hour till evening, and every two hours through the night; the membrana tympani was incised through its whole width in the posterior segment. After recovering from the ether, the patient seemed brighter, and in reply to questions expressed himself relieved; he slept well without any narcotic.

*June 2d.*—Much less pain than before the operation; paralysis of the facial less; tongue now protruded straight; can speak quite clearly; very little stupor; liquid diet.

*June 3d.*—Yesterday evening one slight convulsion, and another this morning; paralysis of facial somewhat increased, and he is not able to speak as well as yesterday; very little pain in the head, and none at all in the mastoid; less swelling and tenderness between mastoid and jaw; douching of tympanum continued every hour day and night with warm water; bowels moved by injection. Pulse 68, temperature 98.4°.

*June 4th.*—No more convulsions, but the paralysis of the face is more marked than yesterday, although that of the tongue is somewhat variable; very little stupor and no pain. Pulse 64, temperature 98.4°. Three leeches were applied around the ear, and the bowels were again moved by injection. The Eustachian tube was catheterized, and the tympanum injected with a solution of muriate of ammonia, gr. v, ad. ʒj; the mucous membrane of the tube was very much swollen; catheterization was continued daily. The watch was heard in the affected ear at a distance of two and a half inches, giving a hearing distance of  $2\frac{1}{2}$ .

*June 5th.*—Condition about the same. Pulse 72, temperature 100.5°.

*June 6th, 7th, 8th, 9th.*—No marked change; the difficulty in speaking still continues, and there is slight stupor; when roused answers no to exactly opposite questions; when asked his name and age points to the card at the head of the bed, where they are inscribed, and in other ways shows that he understands what is said to him.

There is now a free discharge of purulent matter from the tympanum through both wound and meatus; the douching is continued every two hours through the day and omitted during the night. An instillation of sulphate of zinc, gr. j, ad. ʒj, twice a day, was ordered for the tympanum. Pulse variable from 70 to 60, temperature also variable from 97.5° to 98.4°.

*June 10th.*—There is a decided improvement; no stupor; the paralysis of both face and tongue is less, and he can speak much more distinctly; is able to recognize the word he wishes to use, but cannot always succeed in pronouncing it; has taken milk, toast, and eggs in fair quantities, but this morning vomited breakfast. Pulse very variable, from 45 to 70, temperature normal. He was ordered brandy and milk iced, and the bromide of potassium was omitted.

*June 14th.*—Has been gaining in every way; paralysis has almost disappeared; his speech is much better; there is no pain or dizziness; he complains of some subjective noise in the ear; discharge from meatus and wound has nearly ceased; examination shows the swelling and redness of the membrana tympani and meatus to have nearly disappeared; air passes freely through the tympanum with a perforation whistle on catheterization.

*June 17th.*—Pulse still very variable and irregular, from 42 to 108. No marked change till to-day, when there is a decided loss of strength and appetite without any known cause; is unable to retain anything except brandy and milk.

*June 19th.*—Improving in strength and appetite; paralysis of tongue has disappeared, and that of face improving daily; no discharge from meatus or mastoid cells, and the cloth tent which has been kept in the wound is removed; the douching is used only once a day, and the water passes freely into the throat from both wound and meatus.

*July 10th.*—The paralysis has entirely disappeared; appetite and strength good, and the patient has been walking about for the last week; the wound is closed to a mere sinus, and no diseased bone is felt; was discharged from the hospital.

The patient reported once a week for the next month; there was some slight return of the headache of short dura-

tion, but otherwise no symptoms of any kind; the sinus over the mastoid closed firmly, and, when seen on October 8th, the patient was to all appearance well. Examination showed a small, persistent opening in the membrana tympani without any discharge. The watch was heard at a distance of twelve inches,  $\frac{1}{4}\frac{2}{2}$ , and there were no subjective noises in the ear.

During the latter part of October the patient was seen once more. He reported that for several days during the previous week he had had quite severe general headache, unaccompanied by vertigo, nausea, or other symptoms, but that he was not confined to the house by it; he had gained decidedly in flesh and strength, and the appetite was good. For several days before I saw him he had had no symptoms whatever, and had felt so well that he had been seeking work all over the city. The ear remained as at the last report. Within a week of this visit I was informed by the mother that he continued well, without complaining of any symptoms whatever, and spent his time about the city seeking work till the afternoon before his death, when he complained of general headache, which passed off during the evening; he slept well till toward morning, when he complained of feeling ill and was given a cup of tea. The next morning he complained of lassitude, and lay in bed later than usual. About 10 o'clock he got up, dressed himself, and was about the house for an hour, apparently well, when he again complained of feeling ill, lay down, vomited, and, in a few minutes, died before medical aid could be summoned. No autopsy was allowed.

The condition of the patient on entrance to the hospital showed trouble with the brain, while the increase in the stupor, paralysis, and inability to speak intelligibly showed the rapid progress of the disease. The paralysis of the right facial, on the opposite side from the ear-disease, proved that if the disease was due to the inflammation of the ear, the brain must be already seriously affected. The previous history pointed to the ear as the origin of the trouble, and, examination showing purulent inflammation of the tympanum and a decided tenderness of the mastoid, it was decided to perforate the mastoid cells, in order that a free exit might be established for any pus secreted in them, and more especially that it might



be possible by thorough douching of the whole cavity to allay the local inflammation. Although the prognosis was considered very unfavorable at the time on account of the extent to which the brain must be involved, it was hoped that by relieving the inflammation of the ear the inflammation of the brain might subside when the irritation which was causing it was removed. The opening of the mastoid cells showed that there was no collection of pus in them. As the direct effect of the operation, the patient expressed himself relieved, which may be referred either to the free bleeding or the douching of the tympanum. The next morning, however, the improvement was marked; he was able to express himself perfectly intelligibly; there was very little stupor; the paralysis of the face was much less, and that of the tongue had disappeared. The two slight convulsions on the second day after the operation marked an increase again in the brain trouble, although the pain in the head and the stupor did not return; the pulse also began to fall below the normal. Examination of the hearing power, previously impossible on account of the stupor, showed it to be fair, and excluded the labyrinth from participation in the inflammation. For the next few days the brain symptoms, although marked, were never as severe as before the operation.

Following this was a decided improvement in every symptom except the pulse; the paralysis of the face disappeared; his speech became nearly perfect, and there was no pain, stupor, or dizziness; the pulse, however, continued very variable, ranging from 42 to 108 per minute, but gradually became normal as convalescence set in. On leaving the hospital he had been absolutely without symptoms for nearly two weeks. During the next three months a few attacks of general headache, the last and most severe one about ten days before death, were the only symptoms complained of, but, notwithstanding these, he had gained in flesh and strength.

The acute inflammation of the brain in the beginning, the period of latency for three months, only interrupted by a few attacks of headache, and the sudden fatal termination, would seem to point to abscess of the brain-tissue which finally ruptured.



The very decided improvement which followed the opening of the mastoid cells and the treatment of the tympanic inflammation, although followed by a partial relapse, is of interest, as in a similar case of less severity it might be the means of so reducing the inflammation that it could subside without causing serious changes in the brain.

2. *Chronic Purulent Inflammation of the Tympanum; Hyperostosis of the Mastoid; Perforation of the Mastoid; Recovery.*—Albert X., aged eleven, applied to me in December, 1875, for an acute exacerbation of a chronic purulent inflammation of the right tympanum. The old otorrhœa was the result of scarlet fever two years before, and had been continuous from the beginning. For about a week before I saw him he had had severe pain in the ear, and over the side of the head, with slight febrile disturbance. Examination showed the right membrana tympani nearly destroyed, and the position of the posterior half of the membrane occupied by a mass of firm, fibrous granulations; Eustachian tube pervious; mucopurulent discharge in the meatus in moderate quantity; no tenderness or swelling of the mastoid. The inflammation of the tympanum was treated by leeches and douching with warm water; but, in spite of this, in a few days, the mastoid became very tender on pressure, and œdematous externally, and the periosteum was incised freely under ether; no pus had formed, and the bone was not softened. The operation was followed by decided relief to the pain in the ear and the tenderness of the mastoid; but in a few days the pain returned with greatly-increased severity, and with increased constitutional disturbance; rapid pulse, nausea, dizziness, and complete loss of appetite. The pain was not referred to the interior of the ear as at the beginning of the attack, but directly to the mastoid process. Opening of the mastoid process was agreed to and performed under ether, with the assistance of Dr. John Homans, a few hours after, the pain having increased very much in the mean time in the mastoid. After exposing the bone by an incision through the periosteum, it was perforated by means of a triangular borer, one-seventh of an inch in diameter, on a level with the meatus, the point of the instrument being directed slightly forward.

It was impossible to recognize when the instrument perforated the inner plate of bone, but occasional examination with the probe showed finally that the mastoid cells had been opened at the depth of one-fourth of an inch from the external surface of the bone, and the end of the probe could be passed into a small cavity. No pus was found, nor could anything be syringed from the cells; water in minute quantities could be forced through the opening into the meatus.

The operation was followed by gradual relief from the pain in the next few days; the wound was kept open by cloth tents; douching of wound and meatus with warm water continued, and eventually the water passed from the opening into the meatus in somewhat larger quantities than at first, but never freely. The granulations of the tympanum became gradually covered with epidermis, the tympanic inflammation subsided, and the discharge ceased.

The wound was kept open for some six weeks, or till all inflammatory symptoms had subsided, and at no time was there an appreciable suppuration from the interior of the bone. It finally closed firmly by granulations without any caries or necrosis, and has remained firm for five months, although there has recently been a slight return of tympanic inflammation, due to a cold.

3. *Purulent Inflammation of the Tympanum; Inflammation of the Subcutaneous Tissue externally; Hyperostosis of the Mastoid; Perforation; Recovery.*—Mrs. D., aged twenty-seven; strong and healthy; was seen in December, 1875. Eleven months before, from a cold, she had an acute purulent inflammation of the right tympanum, and, since then, has had a continuous otorrhœa on that side, with more or less pain. Seven months from the beginning of the attack, soon after confinement with her third child, a swelling, the size of a pullet's egg, appeared a little above and behind the right auricle. From that time there has been unilateral headache on that side; marked tenderness of the swelling, and pain in the ear, gradually becoming worse, till I saw her, when she was in high fever with chills, and rapid pulse, anxious countenance, and complete loss of appetite.

Examination of the ear showed a slight purulent discharge,

the membrana tympani destroyed, and its position occupied by a firm swelling of the mucous membrane; Eustachian tube slightly pervious. The tumor, which had not increased since its first appearance, was a little above and behind the auricle; was red, firm, immovable, and circumscribed, but without fluctuation; there was no swelling or tenderness of the lower part of the mastoid; there were no decided brain symptoms.

Under ether an incision was made through the tumor down to the bone; no pus was found, and the bone was not softened. The tumor seemed to be a non-suppurative inflammation of the subcutaneous tissue. A poultice was applied, and morphine ordered *pro re nata*.

The free bleeding from the incision and the relaxation of the tissues gave decided relief to the pain, headache, and fever, and the tumor slowly disappeared by suppuration, so that in a fortnight the wound had healed, and no vestige of the tumor remained, except a little induration. Soon after, however, pain and tenderness developed themselves in the point of the mastoid, with occasional sharp burning pain on the left side of the vertex of the head, and the otorrhœa continued. In spite of leeching and douching the ear, and poulticing the mastoid, the pain increased in the ear and mastoid, and there were also dizziness, nausea, and pain in the occiput, which made me fear brain-trouble; at no time was there, however, any return of the fever or marked change in the pulse. The mastoid was now opened under ether, as in the previous cases, by means of the triangular stilet of a trephine; the cavity was only reached after perforating to the depth of about half an inch; water could be syringed through to the throat and meatus in small quantities; no pus was evacuated.

The wound was kept open for six weeks, and treated by douching and poulticing, and the tympanic inflammation was treated in the usual way. The direct effect of the operation was not evident, but the pain and tenderness of the mastoid slowly improved, and in four weeks had disappeared. After being kept open six weeks till all otorrhœa had ceased, and the tympanic mucous membrane had assumed a tolerably healthy appearance, the wound healed.

Occasional dizziness, nausea, and pain in the vertex and

occiput, were felt for the next three months, and occasionally there was a slight recurrence of tenderness of the mastoid, which passed off with poulticing. The pulse and temperature continued normal. For the last three months the patient has been free from symptoms, and is well apparently.

4. *Acute Purulent Inflammation of the Tympana; Hyperostosis of One Mastoid; Perforation; Recovery.*—Sarah S., aged twenty-four, not strong, but without special disease; subject to severe tonsillitis, with which there was four years ago acute catarrhal inflammation of both tympana, from which she recovered perfectly under treatment. In the latter part of January, 1876, she was seized with chills, sore-throat, headache, cough, and anorexia, and again developed a severe inflammation of both tonsils; two weeks from the beginning of the illness she became very deaf, and on February 16th entered the City Hospital. At the time of entrance both tonsils were much swollen, nearly occluding the passage to the fauces; the right one the largest, and somewhat ulcerated on its surface. Some pain in both ears, but not severe; deafness extreme. Pulse 70, temperature 98.4°, respiration 20. Mouth-wash of chlorate of potass. and sulphate of quinine, gr. iij, 4 times daily, was ordered.

On the 21st I saw her for the first time. There had been a severe chill lasting half an hour during the previous night. Examination of the ears showed purulent inflammation of both tympana, with ruptures of both drum-membranes; no tenderness of the mastoids. Douching and hot-water instillations were ordered for the ears; the quinine was omitted.

The chills recurred daily during the next eight days, but gradually became less severe. The inflammation of the tonsils and of the tympana slowly improved, and the general condition was better; the discharge from the ears diminished, and Politzer's inflation was used daily, giving a distinct perforation whistle on each side; the hearing improved. On March 1st, however, decided but not extreme tenderness with slight œdema was noticed over the lower points of both mastoids. Poultices were ordered over both mastoids.

*March 1st*, P. M., pulse, 104; temperature, 100.5°; respiration, 26.



2d, A. M., pulse, 80; temperature,  $97.2^{\circ}$ ; respiration, 18; P. M., pulse, 76; temperature,  $100.2^{\circ}$ ; respiration, 20.

3d, A. M., pulse, 72; temperature,  $98.2^{\circ}$ ; respiration, 20; left mastoid better, the right still tender; pain over right half of head; P. M., pulse, 64; temperature,  $98.6^{\circ}$ ; respiration, 16.

4th, A. M., pulse, 80; temperature,  $98^{\circ}$ ; respiration, 18; P. M., pulse, 68; temperature,  $98^{\circ}$ ; respiration, 16.

5th, A. M., pulse, 68; temperature,  $99^{\circ}$ ; respiration, 24; confined to bed with weakness; P. M., pulse, 68; temperature,  $98.8^{\circ}$ ; respiration, 15.

6th, A. M., pulse, 56; temperature,  $96.8^{\circ}$ ; respiration, 14; P. M., pulse, 68; temperature,  $98^{\circ}$ ; respiration, 20.

7th, A. M., pulse, 84; temperature,  $98^{\circ}$ ; respiration, 20; right mastoid improving, left one not sensitive; free discharge from right meatus, very little from left; P. M., pulse, 60; temperature,  $97^{\circ}$ ; respiration, 14.

8th, A. M., pulse, 72; temperature,  $98^{\circ}$ ; respiration, 18; P. M., pulse, 68; temperature,  $97.8^{\circ}$ ; respiration, 16. Up and dressed.

9th, A. M., pulse, 64; temperature,  $97.2^{\circ}$ ; respiration, 16.

11th, A. M., pulse, 96; temperature,  $98.8^{\circ}$ ; respiration, 28.

12th, P. M., pulse, 92; temperature,  $101.4^{\circ}$ ; respiration, 26. Complains of headache all over the head; delirious at times.

13th, A. M., pulse, 100; temperature,  $99.5^{\circ}$ ; respiration, 22—to-day recurrence of tenderness and swelling over left mastoid with increased discharge from left tympanum and diffuse inflammation of left meatus; right mastoid better; discharge from right tympanum much less; five leeches to left mastoid; frontal headache and pain in occiput; Dover's powder, *pro re nata*—P. M., pulse, 88; temperature,  $99.4^{\circ}$ ; respiration, 20.

14th, A. M., pulse, 74; temperature,  $97.4^{\circ}$ ; respiration, 20; P. M., pulse, 90; temperature,  $98.7^{\circ}$ ; respiration, 24.

15th, A. M., pulse, 80; temperature,  $98^{\circ}$ ; respiration, 18; P. M., pulse, 74; temperature,  $97.4^{\circ}$ ; respiration, 18.

16th, A. M., pulse, 60; temperature,  $97.2^{\circ}$ ; respiration, 16.

Tenderness of left mastoid less, and for the next four days seemed to be improving, although the left mastoid continued



decidedly sensitive but not painful. The right ear was healed. The inflammation of the tonsils had subsided.

*March 22d.*—A recurrence of diffuse inflammation of the left meatus with loss of appetite and occasional slight vertigo.

*24th.*—While at breakfast appeared faint and could not speak; no loss of motion or sensation; no convulsion. When I saw her half an hour after, she was extremely restless, trying to get out of bed, and pointing to the forehead and back of head, as if there was pain at these points; no nausea or vomiting. Pulse, 100. An ice-bag was applied to the head and she soon dropped to sleep, and awoke in an hour perfectly conscious and able to speak; she remembered nothing of the attack.

Similar but less severe attacks recurred several times during the next few days. The left mastoid continued tender, but without œdema or pain. Slight, ill-defined headache most of the time, referred chiefly to the left side.

*March 25th*, A. M., pulse, 80; temperature, 97.8°; P. M., pulse, 87; temperature, 98.3°.

*26th*, A. M., pulse, 96; temperature, 98.2°; P. M., pulse, 92; temperature, 99°.

*27th*, A. M., pulse, 94; temperature, 98°; P. M., pulse, 90; temperature, 98.2°.

*28th*, A. M., pulse, 84; temperature, 98.3°.

To-day patient first consented to an operation which I had been desirous of performing for several days on account of the marked head-symptoms. The left mastoid was opened under ether by a triangular borer on a level with the meatus, as in the previous cases, and the cells were reached only after perforating the bone for more than one-fourth of an inch. Nothing was evacuated. The wound was kept open by a cloth-tent, and the opening douched once a day with warm water which was felt slightly in the throat. A flaxseed poultice was applied.

*28th*, P. M., pulse, 102; temperature, 97.8°.

*29th*, A. M., pulse, 108; temperature, 97.5°; very decided relief to the headache, and no recurrence of unconsciousness or delirium; P. M., pulse, 104; temperature, 99°.

30th, A. M., pulse, 114; temperature, 98°; P. M., pulse, 120; temperature, 100°.

31st, A. M., pulse, 120; temperature, 98.4°; slight chill with inclination to faint, soon better; no loss of speech or consciousness; from this time convalescence was uninterrupted; P. M., pulse, 92; temperature, 99.4°.

April 1st, A. M., pulse, 112; temperature, 98.3°; P. M., pulse, 96; temperature, 98.8°.

5th.—The use of tents was omitted and the wound healed rapidly, and on April 10th she was discharged. Two months afterward she remained well.

In all of these cases the thickness of bone which was perforated, varying from one-fourth of an inch in a child of eleven years to half an inch in an adult, would leave no doubt in regard to the existence of hyperostosis. The difficulty which was experienced in passing water through the mastoid into the tympanum, even after the perforation had entered a distinct cavity, as proved by the probe, would show that the same condition existed within the cells as in the external wall.

In none of the cases was there any history of previous mastoid disease, and three of them may be regarded as instances of more or less acute hyperostosis. In the fourth case, following acute purulent inflammation of the tympanum, there would seem to be no possibility of referring the disease to any long-continued disease, as the ears had been previously healthy; in two of the other cases there had been, it is true, chronic tympanic inflammation for a long time, but the mastoid trouble was very recent; in the last case (No. 3) there had been mastoid inflammation probably for months.

In three of the four cases the mastoid disease was accompanied by pain, usually severe, referred by the patient not only to the ear but also to the mastoid itself; in the fourth there was no decided pain in the mastoid. In all four cases there was marked tenderness of the bone on pressure; in only one, however, was there any œdema or other symptom of external periostitis. In all of them a series of ill-defined symptoms, headache, nausea, and dizziness, were present, which would lead any one familiar with the insidious way in

which the brain is affected from purulent tympanic inflammation to fear trouble with the brain; in none, however, except the one fatal case, was there any very great or long-continued variation of the pulse.

In all of the cases, I am confident that the mastoid cells were opened; indeed, in each I was able, although with difficulty, to force water into the meatus or throat, but notwithstanding this no pus or anything else was evacuated from the cells. In the first and fourth cases the relief from the operation was very marked and immediate; in the other two cases the effect of the operation was not so decided, although they both gradually improved from that time, and eventually recovered. In the first case the relief to the brain symptoms was very decided, and I can only explain the final fatal termination by supposing that a local intense cerebritis had been set up in some part of the brain, which failed to be relieved when the rest of the brain was relieved of its congestion.

It is noticeable that in none of the cases was the operation followed by severe febrile reaction; in fact, in most of them there was no febrile disturbance noticed after the operation.

In the series of mastoid cases reported by Schwartze in the *Archiv für Ohrenheilkunde*, vols. x. and xi., five cases of hyperostosis are given, in which perforation of the cells was performed or attempted; in two of these the operation was followed by almost immediate relief to the pain and other urgent symptoms; in two others the operation gave gradual relief; while in the fifth case there were no urgent symptoms present, the operation being undertaken for a necrosis.

Dr. Buck, in his admirable article on mastoid disease in the "Archives of Ophthalmology and Otology," vol. iii., says, in speaking of hyperostosis, that, "while this form constitutes a distinct pathological condition, we are not yet in possession of sufficient clinical facts to guide us to a positive diagnosis;" and in his description of the disease says, "Its progress is so insidious, and so rarely accompanied by any marked symptoms, that it is only at the *post-mortem* examination, or when called upon to trephine the bone, that we discover the existence of this condition." That the diagnosis is as yet uncertain, these cases have convinced me, but they also show that the disease

may be accompanied by very marked symptoms simulating those of the other varieties of mastoid inflammation. Again, he speaks of this hyperostosis as associated often with "a deposit of cheesy material produced by a retrograde metamorphosis of pus, epithelial cells, and mucus," a condition undoubtedly found in *post-mortem* examinations, but in these cases of mine a careful examination with the syringe and probe failed to develop anything of the kind, and I think it more likely that such deposits are rather the result of a long-continued inflammation of the internal periosteum than of the true hyperostosis. Certainly such deposits are not necessarily associated with the acute or subacute hyperplasia of the bone.

At a meeting of the Paris Academy of Sciences in 1875, Prof. Gosselin read a paper on "Osteo-neuralgia of the Long Bones,"<sup>1</sup> in which he advocated trephining in all cases of diseased bone, whether inflammatory or neuralgic, in order to relieve the pain if not to cure the disease. From the cases of hyperostosis of the mastoid which have been reported, and from my experience in these cases, I think the same rule could be applied to the inflammatory diseases of the mastoid bone. Of ten cases of mastoid hyperostosis with which I am familiar, and in which the bone was perforated, nine were relieved, and the tenth case proved to have a necrosed sequestrum not loosened;<sup>2</sup> in five of these cases the operation was followed by relief to pain and other severe symptoms within a very short time (one to three days), while in the other four the relief was more gradual.

<sup>1</sup> *British Medical Journal*, November 13, 1875. Paris Letter.

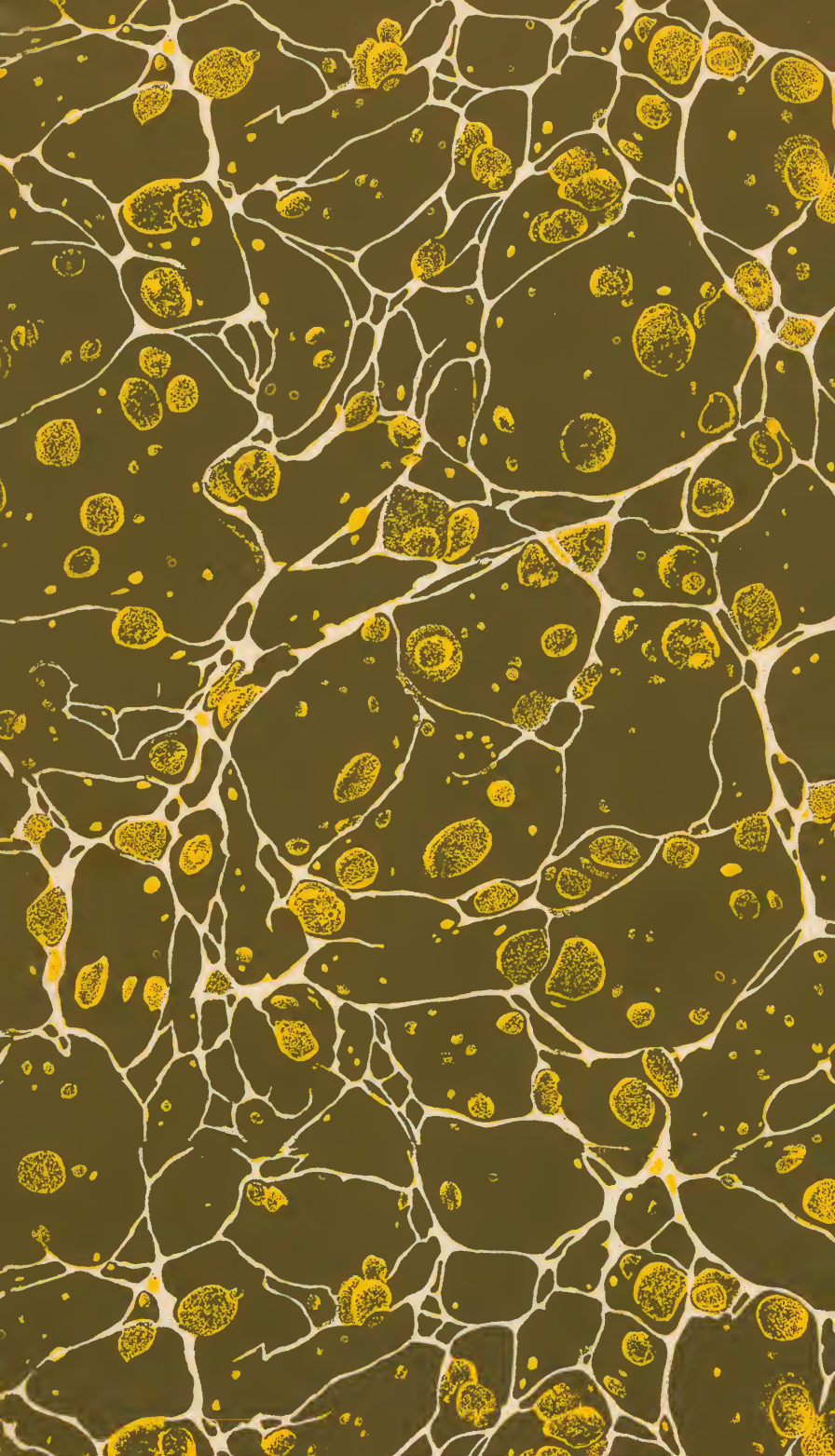
<sup>2</sup> Five cases by Schwartze, *op. cit.* From here reported. One by Dr. Agnew, American Otological Society, 1870.

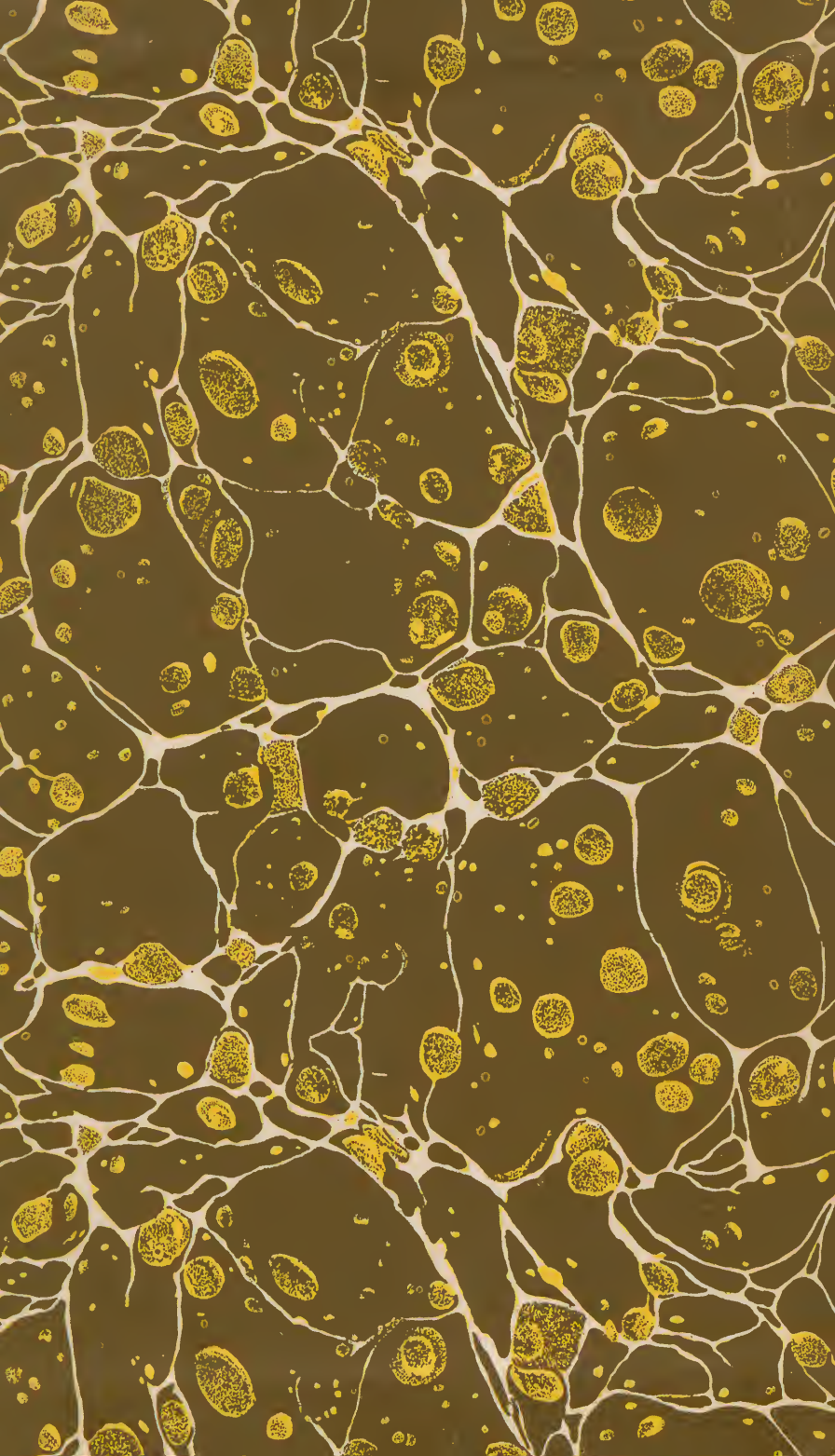


13. Buckman









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